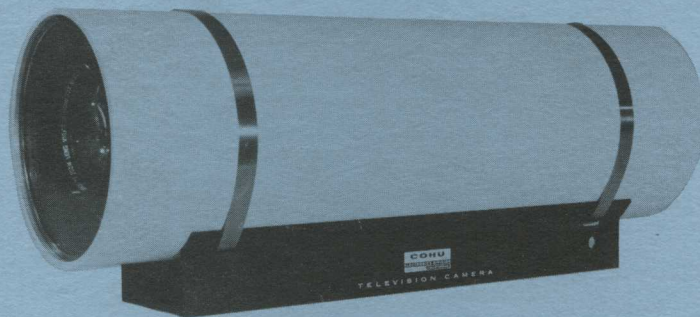




OPERATING AND MAINTENANCE INSTRUCTIONS FOR

HIGH RESOLUTION TELEVISION CAMERAS 7120/7210B Series

**OPERATING AND MAINTENANCE
INSTRUCTIONS FOR 7120/7210B SERIES
TELEVISION CAMERAS**

SERIAL NUMBER EFFECTIVITY:

7120 – 2-0279 and ON
7210B – 3-0040 and ON

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August 1, 1978

INSTRUCTION MANUAL CHANGES

SECTION II – CAMERA MAINTENANCE

Change No. 1
10-19-79 19-

Code No. 6X-619(A)

- a. In Paragraph 2-8, add the following:
 - h. Spectrum analyzer, range 1 kHz to greater than 50 MHz.
- b. In Paragraph 2-10, add to step c the following:

“On video board remove A1 filter board and connect jumper between pins 13 and 14.
Remove jumper between pins 4 and 5.”
- c. In Paragraph 2-10, add the following step:
 - g. Remove jumper between 13 and 14 on video board, replace filter board and jumper between 4 and 5.

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7120/7210B SERIES TV CAMERAS
SECTION I
DESCRIPTION/INSTALLATION/OPERATION

1-1. GENERAL DESCRIPTION

Cohu 7120/7210B Series High-Resolution Cameras (see front cover) are electrically identical compact units designed for closed-circuit television applications where the highest-quality picture reproduction is required and limited space is available for installation. The main difference between the 7120 and the 7210B is in the physical packaging. With very few exceptions, the same verbal circuit descriptions, waveforms and adjustments apply.

The 7120 is used in applications where high resolution and details are requirements such as inspection, measurement, microscopy and other medical, scientific, and industrial instrumentation uses. Its small size and light weight make it ideal for interfacing with delicate instruments such as microscopes.

The 7210B camera is housed in a rugged weather-resistant sealed housing and is designed for unattended continuous - duty operation in adverse environments where superior resolution and detail is necessary.

The cameras operate in conjunction with a 7900 Series Camera Control, a device that connects to the camera with a single multiconductor cable. The length of this cable may, without adversely affecting picture quality, be up to 2000 feet for systems with 8 MHz bandwidths, 1000 feet for systems with 16 MHz bandwidths, and 500 feet for systems with 32 MHz bandwidths. Within broad limits the camera performance is unaffected by extremes of temperature, humidity, vibration, shock or dynamic pressure.

The 7120/7210B cameras are capable of operating at any horizontal scan rate in the range from 525 to 1225 lines per frame at frame rates of 25 or 30 per second 2:1 interlaced, or at any horizontal scan rate from 1349 to 2047 lines per frame at frame rates of 15 per second 4:1 interlaced.

A typical closed-circuit television system incorporating the 7120/7210B Series Cameras is shown in Figure 1-1.

1-2. ELECTRICAL DESCRIPTION

The circuits in the 7120/7210B Cameras (see Figure 1-2) include: (1) an image tube that converts visual images into electronic signals; (2) a video preamplifier that converts target signal current from the image tube into a video voltage signal before it is transmitted by cable to the camera control; (3) deflection and focus current generators for coils that produce magnetic fields to deflect and focus the scanning beam in the image tube; (4) noise filters for dc voltage supply lines going to various electrodes at the image tube; (5) blanking and protection circuits that generate pulses or bias voltages for turning off the scanning beam during retrace or for keeping it off to protect the image tube from damage if a deflection circuit fails; and (6) a high-voltage supply that develops dc potentials for two of the electrodes at the image tube.

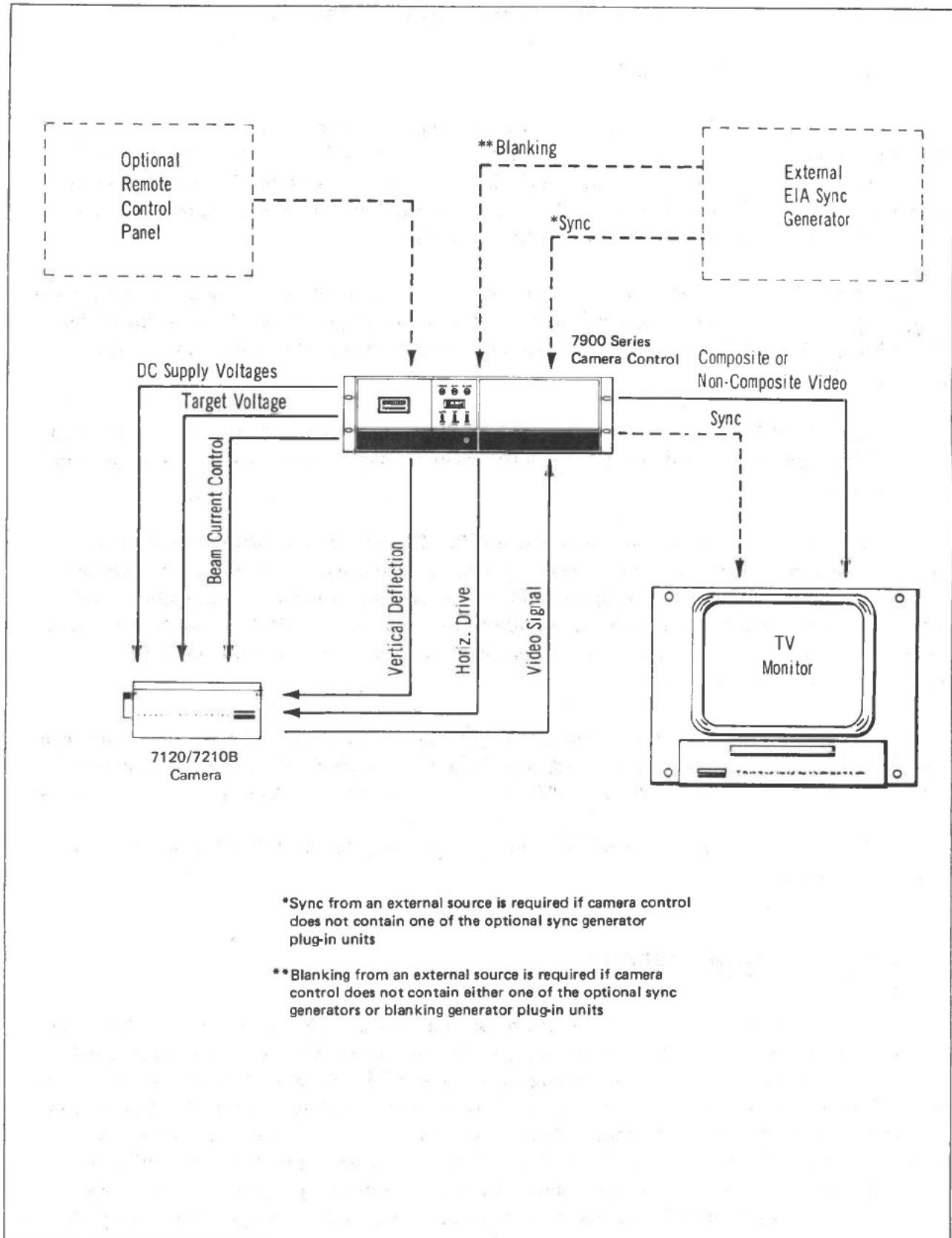


Figure 1-1. Basic Block Diagram of a Closed-Circuit Television System
using the 7120/7210B Series Cameras

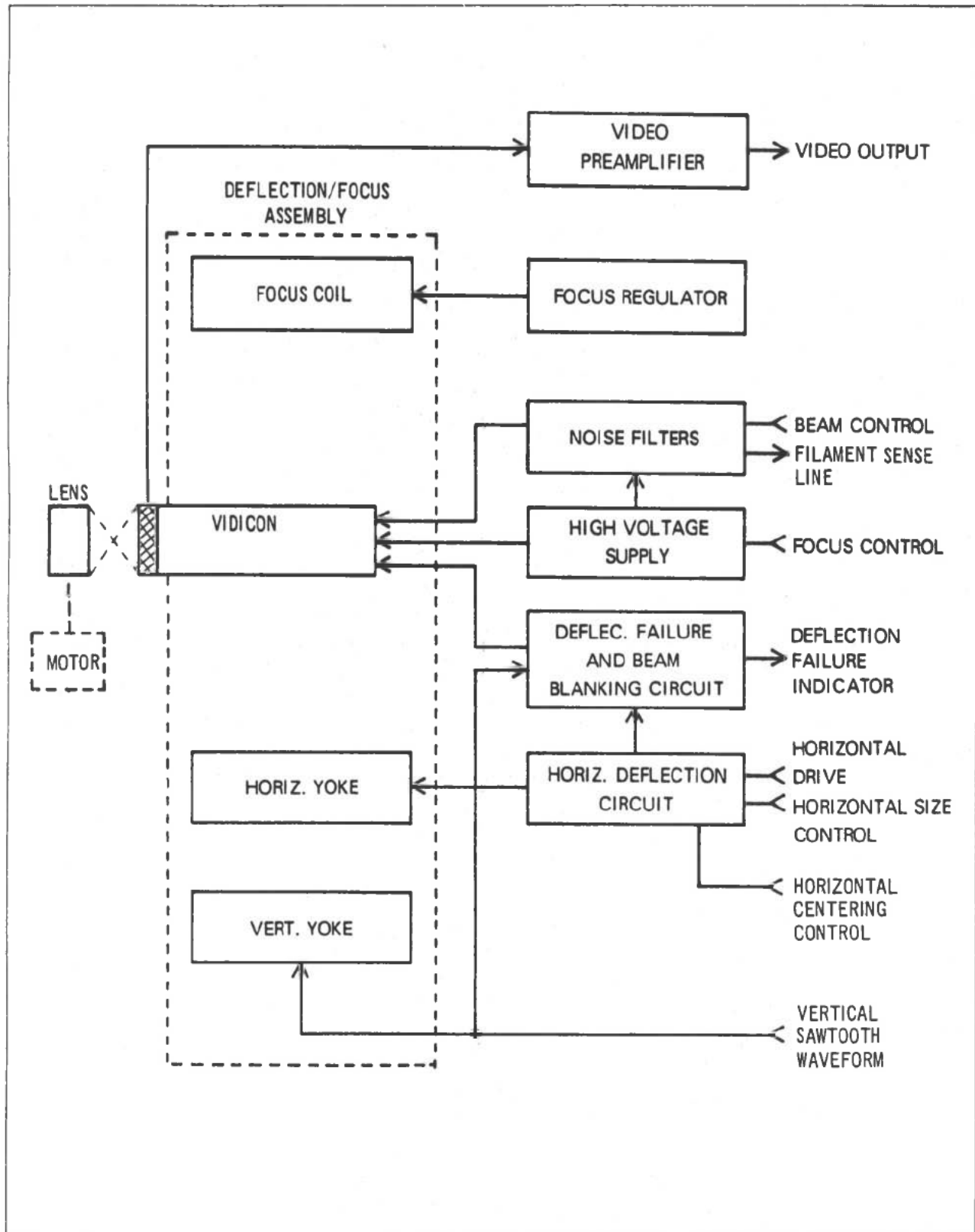


Figure 1-2. Basic Block Diagram, 7120/7210B Series Cameras

1-3. PHYSICAL DESCRIPTION

The 7120 Camera is enclosed in a rectangular aluminum housing (Figure 1-3) with a scuff-resistant finish. Other than the image tube, the active components in the camera are solid-state, the circuits being designed around the latest state-of-the-art transistors and integrated circuits. In most all cases these components are installed on easily-serviced, plug-in, printed circuit boards. The camera has installed on its front end a lens "C" mount that accepts most types of 16-millimeter fixed focal length and zoom lenses. On the rear of the camera is a single receptacle for a multiconductor cable from the 7900 Camera Control. In the base of the camera there are three threaded holes. These holes are provided so the camera can be bolted, if desired, to standard tripod, pedestal or pan-and-tilt units.

The 7210B camera is enclosed in a cylindrical barrel (Figure 1-4) machined of sturdy, highly corrosion-resistant aluminum alloy, finished with a heat-reflecting, weather-resistant enamel. The barrel is strapped to a cradle base which has three ¼-inch-20 threaded holes used for mounting purposes. Underwater operation of the camera in depths up to 60 feet is possible with a special factory installed connector. Additional factory modifications will increase operational depth to 200 feet. The barrel diameter is 6-inches (15.24cm). The length is 11.0-inches (27.94cm) if the camera has an exposed type lens. The enclosed lens cameras will have barrel enclosure lengths depending upon the type of lens used as shown in Figure 1-4 and Table 1-1.

The 7210B exposed lens camera can be a "sealed" exposed lens or a standard exposed lens model. A 7210B camera with "sealed" exposed lens has its barrel front end closed with a metal plate which is locked in place with a snap ring and hermetically sealed with an O-ring. An off-center lens well in the plate accepts most types of 16 millimeter format lens which are motorized or non-motorized. Those 7210B cameras with an enclosed lens, have their front barrel end closed off with a non-reflecting glass window. The rear end of the barrel housing is closed with a metal plate. A multiconductor cable connector and a Schrader valve are installed in the rear plate. The Schrader valve allows the camera interior to be purged with dry nitrogen or air to be maintained at atmospheric pressure.

1-4. ACCESSORIES

A partial list of accessories that can be ordered from Cohu for use with the 7120/7210B Series Cameras include:

- a. Motorized or manually adjustable 16 millimeter lenses. (A wide variety of fixed focal length and zoom lenses are available.)
- b. Motorized constant-speed or variable-speed pan and tilt units
- c. Remote controls for motorized lenses or pan and tilt units
- d. Tripod
- e. Lens adapters for 35mm lenses
- f. Infrared sun filter
- g. Test equipment (camera test jig and dot bar generator)

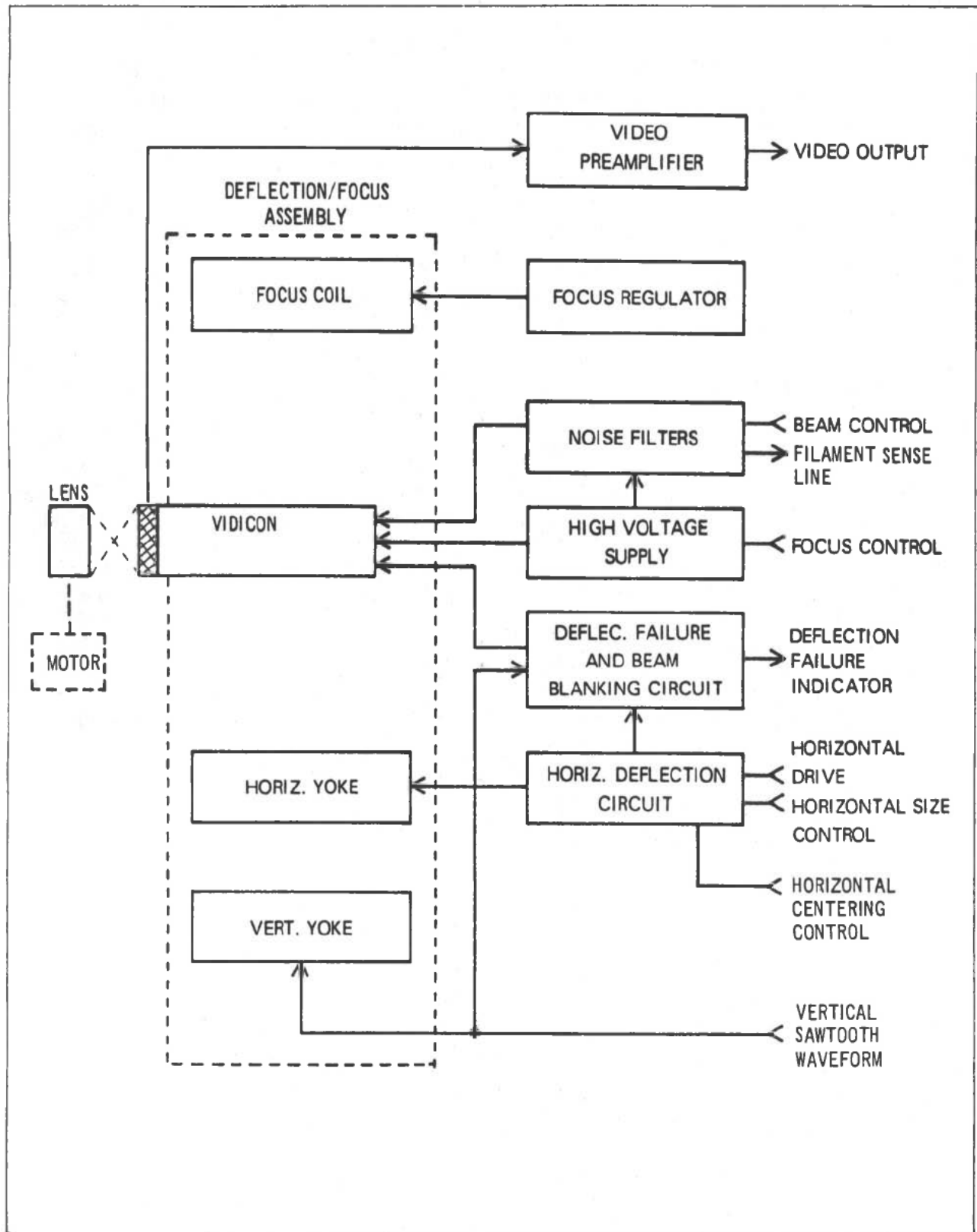


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- f. Infrared sun filter
- g. Test equipment (camera test jig and dot bar generator)

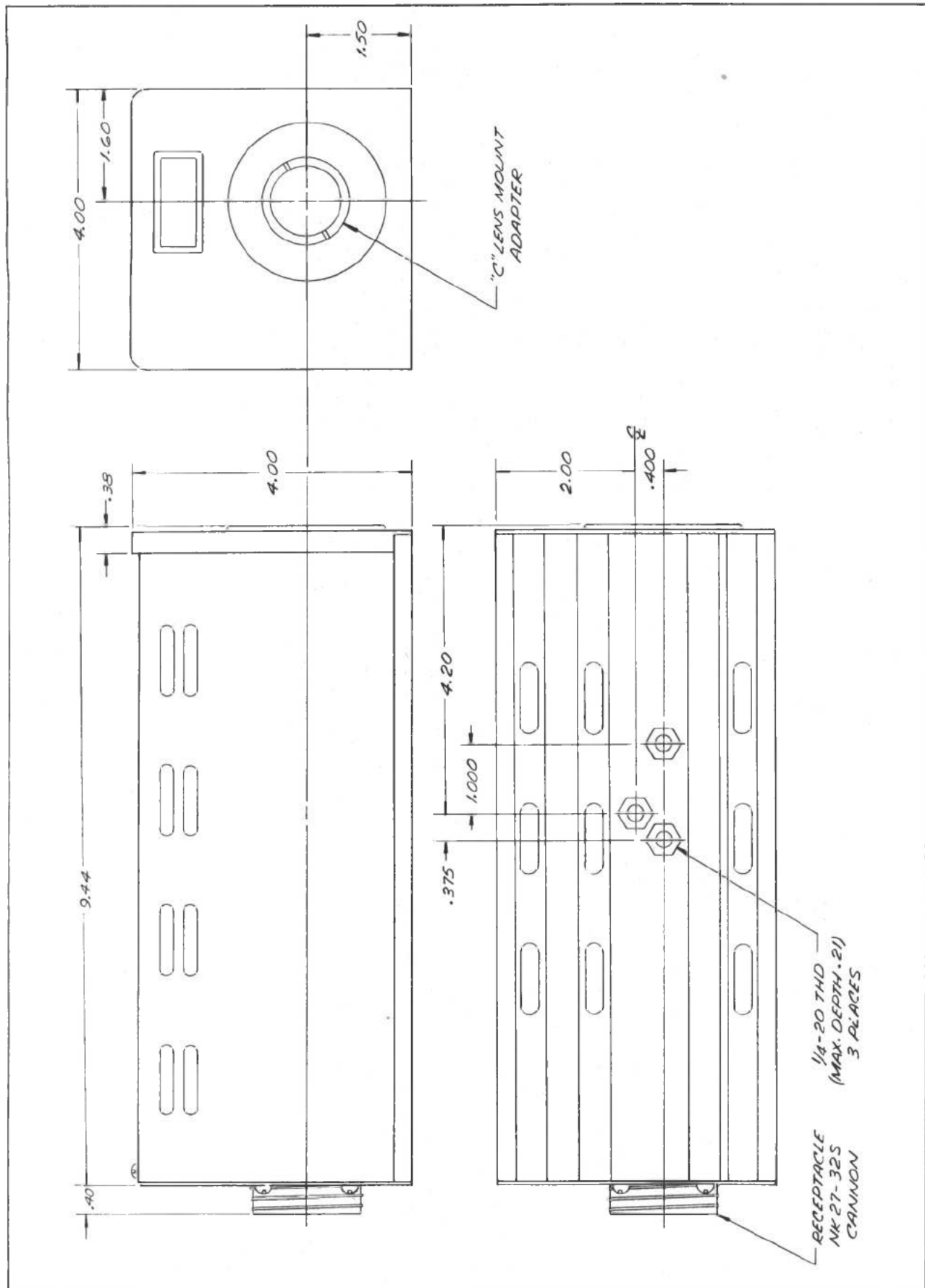


Figure 1-3. Outline Dimensions, 7120 Series Camera

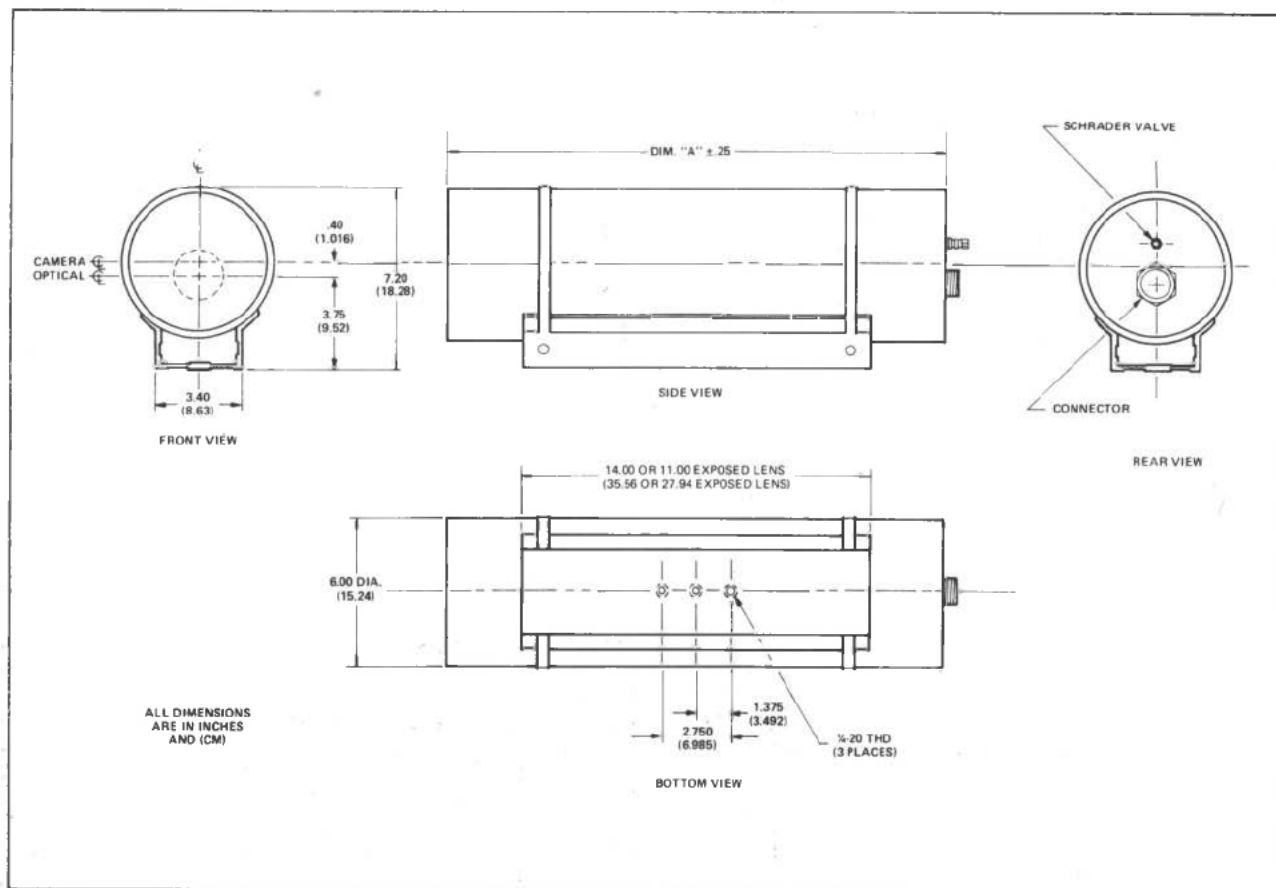


Figure 1-4. Physical Dimensions of 7210B Series Cameras

Table 1-1. Physical Sizes, Weights, and Lens Assemblies for the 7210B Series Cameras

Model No.	"A" Dimension		Lens	Weight	
	in.	cm.		lbs.	kg.
7210B-011	11.0	27.94	Exposed Lens Camera (Less Lens)	14.5	6.59
7210B-002	20.8	52.83	10:1 Zoom (f/1.8) No Extender	25.0	11.36
7210B-003 7210B-004	23.0	58.42	10:1 Zoom (f/1.8) with 1.5X Extender 10:1 Zoom (f/1.8) with 2X Extender	26.0	11.82
7210B-005 7210B-006 7210B-007	19.2	48.77	10:1 Zoom (f/1.8) No Extender 10:1 Zoom (f/2.8) with 1.5X Extender 10:1 Zoom (f/2.8) with 2X Extender	22.0	10.0
7210B-012	14.2	36.07	AL-1D, AL-1C 1/2" f/1.4	15.5	7.05
7210B-013	15.0	31.10	AL-2D, AL-2C 1" f/1.4 AL-4D, AL-4C 2" f/1.4 AL-15B 1" f/0.95	16.5	7.5
7210B-014	18.2	46.23	AL-5D, AL-70 3" f/1.4	19.0	8.64
7210B-015	19.2	48.77	AL-8A 6" f/2.8	20.0	9.09

1-5. SPECIFICATIONS

Electrical, mechanical and environmental specifications for the 7120/7210B Camera are listed in Table 1-2.

Table 1-2. 7120/7210B Series Camera Specifications (when operating with a 7900 Series Camera Control)

ELECTRICAL

Input Signal Requirements: Horizontal drive, vertical deflection (supplied by 7900 Series Camera Control)
Input Power Requirements: -10V, +20V, +28V, +300V and +6.3V (supplied by 7900 Series Camera Control)
Video Output: Noncomposite, white negative, 0.2V p-p from 75-ohm source
Vertical Sweep Rate: 60 Hz (30 frames per second with 2:1 interlace or 15 frames per second with 4:1 interlace)

Horizontal Sweep Rate:

No. Horiz. Lines	Horizontal Sweep Rate
525	15,750 Hz
675	20,250 Hz
729	21,870 Hz
875	26,250 Hz
945	28,350 Hz
1023	30,690 Hz
1125	33,750 Hz
1225	36,750 Hz
1349	20,235 Hz
1749	26,235 Hz
2047	30,705 Hz

Scanning Patterns: 525 to 1225 lines/frame at frame rate of 30 per second 2:1 interlaced, or 1349, 1749, or 2047 lines/frame at a frame rate of 15 per second 4:1 interlaced.

Image Tube: Standard is 1" type RCA 8541A vidicon, 6" length. Silicon diode array and lead oxide types also can be used.

Resolution: Typical resolutions for cameras with 30 frame/sec frame rate and an RCA 8541A vidicon in the camera are listed in the following chart:

HORIZONTAL RESOLUTION				VERTICAL CENTER RESOLUTION	32-MHz CORNER RESOLUTION
LINE RATE	8-MHz BANDWIDTH	16-MHz BANDWIDTH	32-MHz BANDWIDTH		
525	650	1200	1400	340	1000
675	525	1050	1400	425	1000
729	500	950	1400	475	1000
875	400	775	1400	575	1000
945	350	675	1300	600	1000
1023	325	625	1200	650	1000
1125	300	550	1100	725	1000
1225	250	500	1000	775	1000

Sensitivity (25 or 30 Frames Per Second)	0.5 footcandle highlight illumination on face of image tube will produce 100 IRE units of video at camera control output terminal.												
Signal-To-Noise Ratio:	Signal-to-noise ratios (signal current at 600na) for various video bandwidths and visual equivalent input noise currents are as listed below: <table><tr><td>VIDEO BANDWIDTH:</td><td>32 MHz</td><td>16 MHz</td><td>8 MHz</td></tr><tr><td>VISUAL EQUIV. INPUT NOISE CURRENT:</td><td>5.2</td><td>2.8</td><td>1.5na rms</td></tr><tr><td>VISUAL EQUIV. SIGNAL-TO-NOISE RATIO:</td><td>30</td><td>39</td><td>45 dB</td></tr></table>	VIDEO BANDWIDTH:	32 MHz	16 MHz	8 MHz	VISUAL EQUIV. INPUT NOISE CURRENT:	5.2	2.8	1.5na rms	VISUAL EQUIV. SIGNAL-TO-NOISE RATIO:	30	39	45 dB
VIDEO BANDWIDTH:	32 MHz	16 MHz	8 MHz										
VISUAL EQUIV. INPUT NOISE CURRENT:	5.2	2.8	1.5na rms										
VISUAL EQUIV. SIGNAL-TO-NOISE RATIO:	30	39	45 dB										
Automatic Light Range:	10,000:1. Peak-to-peak video level at camera control output remains constant to within 6 dB for a change in target illumination from 0.1 footcandle to 1000 footcandles.												
Resolution Stability versus Temperature:	Dependent mostly on image tube degradation. Tube faceplate operates at 15°C above the camera case temperature. Other causes of degradation contribute less than 2 lines/°C reduction of horizontal and vertical resolution.												
Resolution Stability versus Input Voltage Variation:	No change over specified power line voltage range for the 7950 Series Camera Control used with the camera.												
Gray Scale Rendition:	Meets stated resolution specifications and resolves all ten shades of gray on EIA TV Resolution Chart, 1956, using 0.5 footcandle highlights illumination on the face of vidicon.												
Signal Transmission Distance (Camera to Camera Control)	2000 feet maximum for systems with 8 MHz bandwidth, 1000 feet for systems with 16 MHz bandwidth, and 500 feet maximum for systems with 32 MHz bandwidth, using AC-29P or equivalent cable.												
Geometric Distortion:	Less than 2% using method outlined in IEEE Standard 202												
Scan Failure Protection:	In the event of vertical scan failure the scanning beam in the image tube is automatically turned off. If a horizontal deflection failure occurs, the high voltages are automatically removed from the image tube.												

MECHANICAL

Dimensions:	(see Figure 1-3 for 7120 and Figure 1-4 for 7210B.)
Weight (Less Lens)	2.27kg net. (5lbs) for 7120 and 6.59kg (14.5lbs) for 7210B.
Type of Lens Mount:	16-millimeter "C" type
Camera Mounting:	Three threaded ¼"-20 holes are provided in base of camera for standard tripod, pan-and-tilt, or pedestal mounting screws.

OPERATING ENVIRONMENTAL RANGES

	<u>7120</u>	<u>7210B</u>
Ambient Temperature:	-20°C to +50°C (-4°F to 122°F)	-20°C to +50°C (-4°F to 122°F)
Air Pressure:	To 3048m (20,000 ft.)	To 15,240m (100,000 ft.)
Vibration (peak random):	±5g's, 30 to 1000 Hz.	±5g's, 30 to 1000 Hz.
Shock (non-operating):	15g's all directions	15g's all directions
Humidity:	To 90%	To 100%

Cohu reserves the right to change specifications without notice.

1-6. RECEIVING INSPECTION

The following should be done immediately upon receipt of equipment to determine if any damage was incurred in transit: (1) examine equipment for visible damage; (2) perform operational testing to ascertain any concealed damage; (3) see Form P-292-5-62-5M enclosed in the packing container.

1-7. WARRANTY

Standard warranty certificate, Form No. S212 (on the inside back cover), applies to this equipment. Instructions and conditions stated or implied in this manual are not to be interpreted in any manner which would conflict with or modify the meaning or intent of the warranty.

1-8. INSTALLATION

Camera installation consists of: (1) mounting it at the desired location (Paragraph 1-9); (2) making cable connections to the 7900 Series Camera Control and, if used, to external sync and blanking signal sources (Paragraph 1-10); and (3) installing an appropriate lens (Paragraph 1-11 and 1-12).

1-9. CAMERA MOUNTING

CAUTION

If the image tube in the camera is a vidicon, it can be irreversibly damaged by exposure to direct rays of the sun or any other source of intense illumination. When the camera is to be operated unattended, and if it is possible that the sun could move into a position that will focus it on the face of the tube, an infrared sun filter should be used on the lens, provided a slight loss in light sensitivity can be tolerated.

Bolt the camera to a tripod, a pedestal, a pan and tilt or any flat surface using the three threaded $\frac{1}{4}$ "-20 holes that are provided in the base of the camera. Position the camera on any angle and locate it anywhere that environmental conditions will stay within the limits specified in Table 1-2.

1-10. CABLE CONNECTIONS

Cable connections for a closed-circuit television system using a 7120/7210B Series Camera is illustrated in Figure 1-5. The length of the cable used to connect the camera to the camera control unit may be up to 2000 feet if the system has an 8 MHz video bandwidth, up to 1000 feet for a 16 MHz video bandwidth, and up to 500 feet for a 32 MHz bandwidth. The camera-to-camera control interconnecting diagrams for the 7120 and 7210B cameras are shown in Figure 1-6 and 1-7 respectively. After initial installation it may be desirable to readjust a CABLE DELAY control at the 7900 Series Camera Control to compensate for the particular cable length being used.

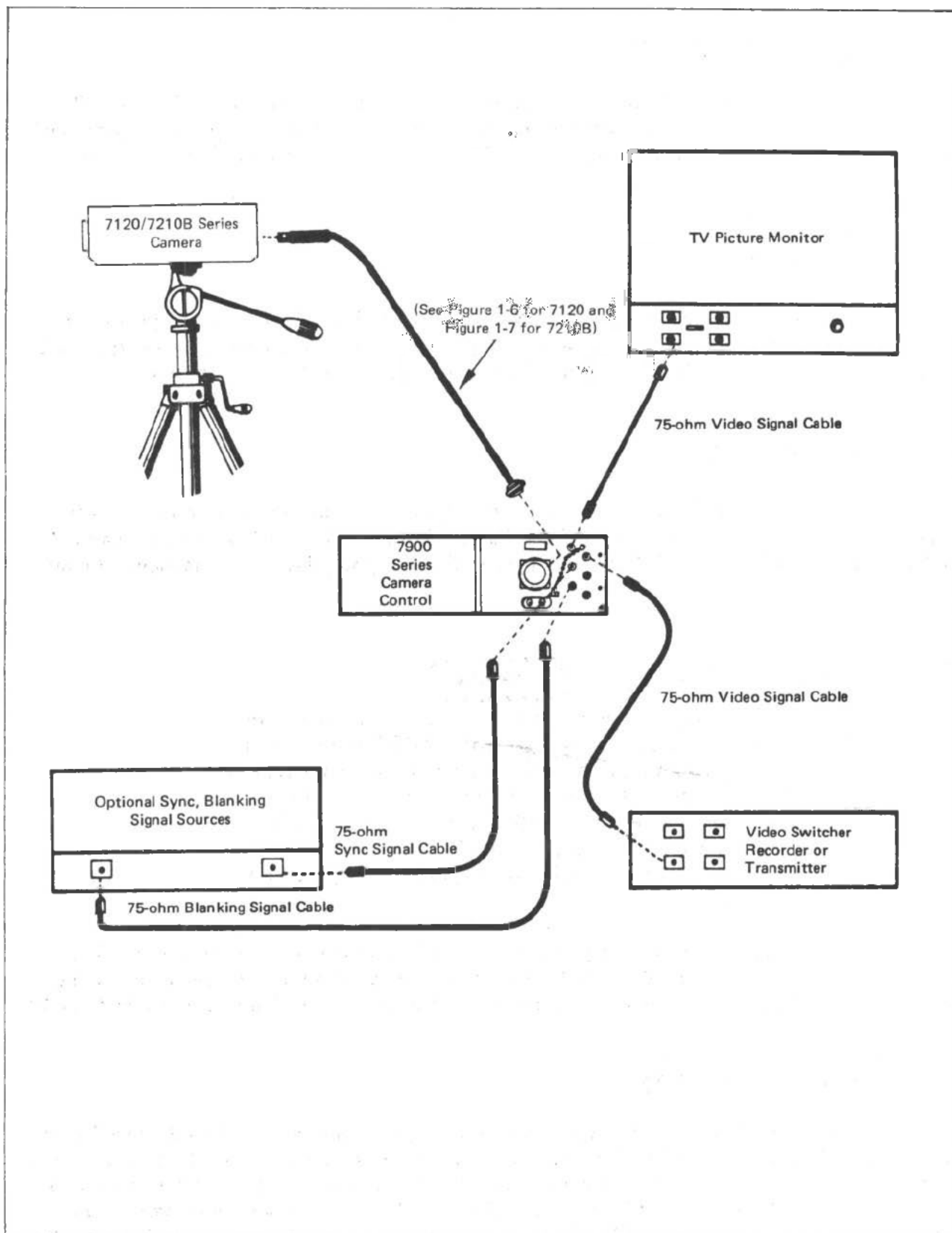


Figure 1-5. Typical Cable Connections for a Closed-Circuit TV System using a 7120/7210B Camera

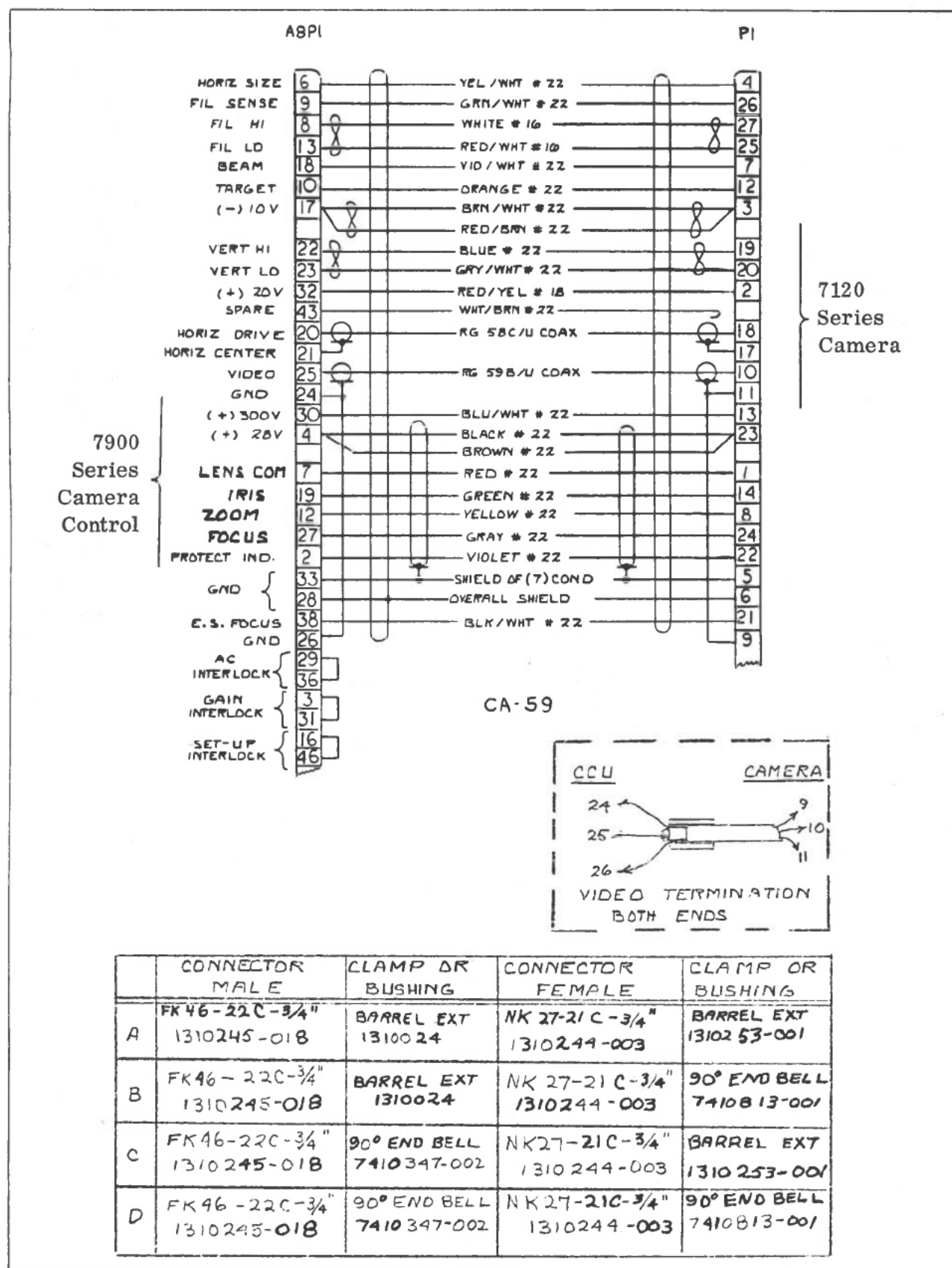
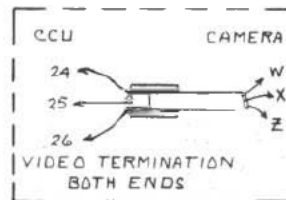
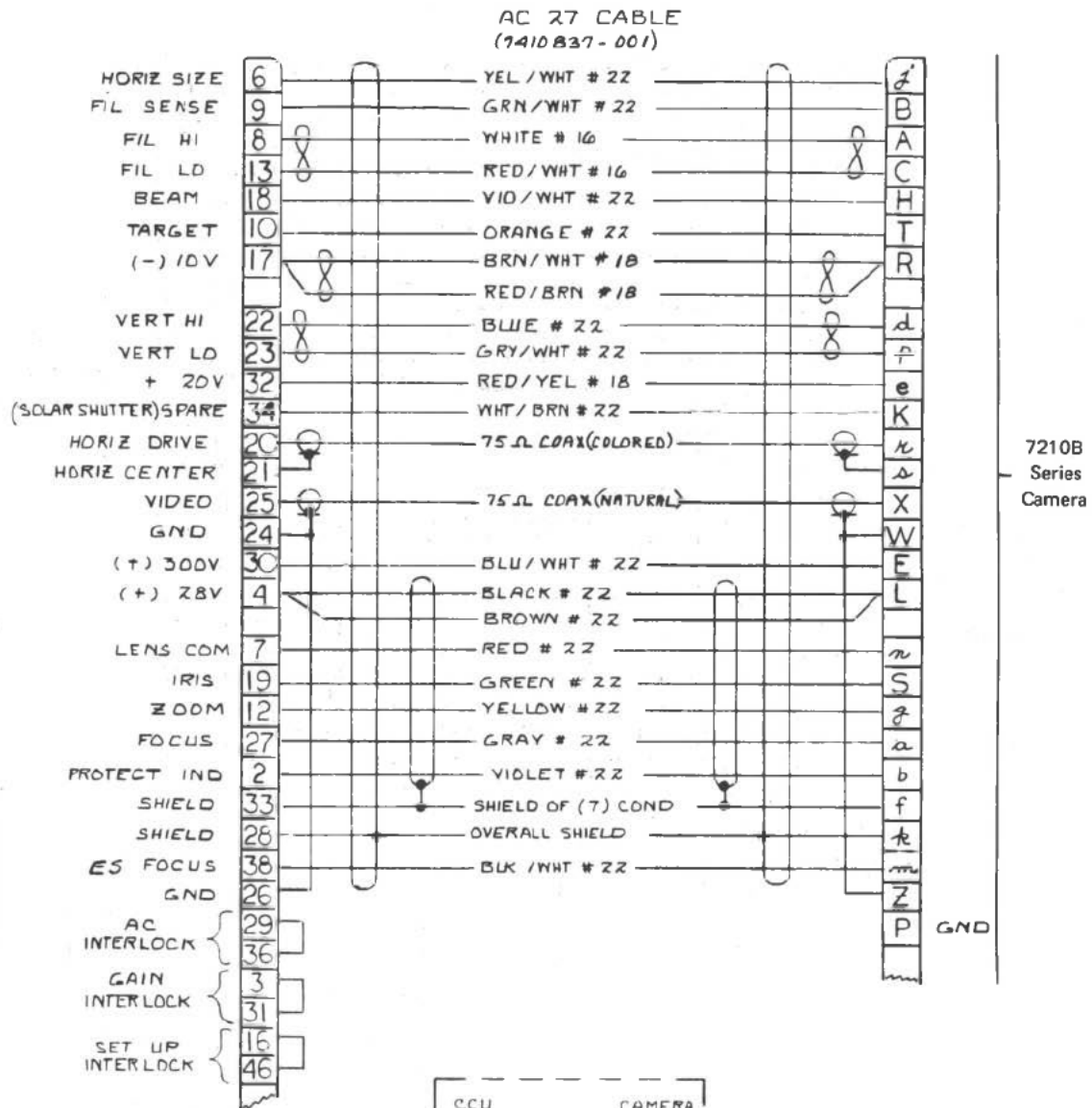


Figure 1-6. 7120 Camera-to-7900 Series Camera Control Interconnecting Cable

7900
Series
Camera
Control



	CONNECTOR MALE	CLAMP OR BUSHING	CONNECTOR FEMALE	CLAMP OR BUSHING
A	FK 46-22C-1" 1310245-018	BARREL 1310024	CA 3106E-28-215 (A105) 0310077-008	N/R
B	FK 46-22C-1" 1310245-018	BARREL 1310024	CA 3106E-28-215 (A105) 0310077-008	90° END BELL 7410472-001 CLAMP 0310021-019
C	FK 46-22C-1" 1310245-018	90° END BELL 7410347-002 CLAMP 0310021-019	CA 3106E-28-215 (A105) 0310077-008	N/R
D	FK 46-22C-1" 1310245-018	90° END BELL 7410347-002 CLAMP 0310021-019	CA 3106E-28-215 (A105) 0310077-008	90° END BELL 7410472-001 CLAMP 0310021-019

Figure 1-7. 7210B Camera-to-7900 Series Camera Control
Interconnecting Cable

1-11. MODEL 7120 LENS INSTALLATION

Cameras not equipped with a lens when shipped from the factory have a threaded "C" mount lens well that is capped with a protective escutcheon button. This lens well accepts most types of 16-millimeter fixed focal length or zoom lenses, motorized or nonmotorized. The appropriate lens to use will depend on: (1) field of view (height and width of scene to be televised); (2) distance from lens to subject; and (3) intensity of illumination on subject. For a detailed discussion of lenses applicable to television cameras refer to Cohu Publication 6-322.

To Install a Lens:

- a. Remove, if one is there, the plastic escutcheon button installed over the lens opening to protect the face of the image tube.
- b. If the face of the image tube or any lens surface is dirty, clean it with isopropyl alcohol or any other good quality lens cleaner, and dry with a soft lint-free cloth.
- c. Screw the lens finger-tight into the lens mount. Sharp focus can be attained only if the distance from the center of the lens to the face of the image tube is correct. This distance is adjustable with a lens adapter ring (Figure 2-2, Section II). If it is impossible to obtain sharp focus by adjustment of the focus ring on the lens itself, or if the calibrated focus setting on the lens when in focus does not correspond with the actual lens-to-scene distance:
 1. Loosen with a hex wrench the setscrew (Figure 2-2, Section II) that holds the lens adapter ring in place.
 2. Put the camera into operation in a system (Paragraph 1-13) and point camera at a test pattern or a piece of printed matter taped to a wall or other plane surface parallel to the face of the camera. Position camera so distance from center of lens to the scene corresponds to the focus setting on the lens.

NOTE

In step 2 it is preferable to use a collimator instead of a test pattern for the lens-adapter ring adjustment. If such a device is used, set the lens focus at infinity and the lens iris fully open.

3. Slowly turn the lens-adapter ring and lens clockwise or counterclockwise in the lens opening until sharp focus is attained, as observed on system TV monitor.
4. Retighten the setscrew on the lens mount to secure the lens-adapter ring in the lens well.

1-12. MODEL 7210B LENS INSTALLATION

Some 7210B series cameras have an enclosed lens, others an exposed lens. Table 1-1 lists the types of lenses that are recommended for the cameras. These lenses are the 16-millimeter format type which fit in a threaded C-mount lens adapter ring installed in a lens well at the front end of the camera. The lens adapter ring is locked in place with a setscrew. If a nonmotorized lens is to be installed in a camera after shipment from the factory or if it is the enclosed type, the lens will be set at f/5.6 and infinity focus unless otherwise specified. To install a lens in a 7210B series camera, perform the following steps:

- a. If camera is exposed lens type, remove plastic escutcheon button if one is plugged into front plate lens well to protect vidicon target. Then, install lens in camera by screwing it clockwise until fingertight, loosen setscrew (Figure 2-5) that locks C-mount lens adapter ring in place. Proceed to step c.
- b. If camera is enclosed lens type, camera chassis will have to be removed from its cylindrical housing before a lens can be installed in camera. Use following steps b1 through b7 to install enclosed type lens. (NOTE: Do not apply power to camera.)

WARNING

Enclosed lens 7210B series cameras have been charged with 5 to 10 psi of dry nitrogen prior to shipment from the factory. This nitrogen should be released through the purge valve on the rear end plate of such cameras before attempting to remove the camera chassis from the barrel housing.

1. Using a straight slot screwdriver for leverage, remove steel snap ring retaining end plate at rear end of camera barrel (Figure 1-8). Using same method, remove steel snap lock rings retaining glass window at front end of camera barrel housing. Remove window from barrel and lay aside on nonabrasive surface.

NOTE

Dessicant packs are used in enclosed lens cameras to maintain a dry atmosphere. Since packs deteriorate rapidly in the open air, the camera should be resealed as soon as possible after it has been opened.

2. Loosen compression pad setscrew at top edge of camera chassis vertical support using hex wrench through front end opening of camera barrel (see Figure 1-9)
3. Remove camera chassis from cylindrical housing by pulling it out through rear opening of camera barrel.
4. Remove plastic escutcheon button if one is plugged into lens well to protect vidicon target.

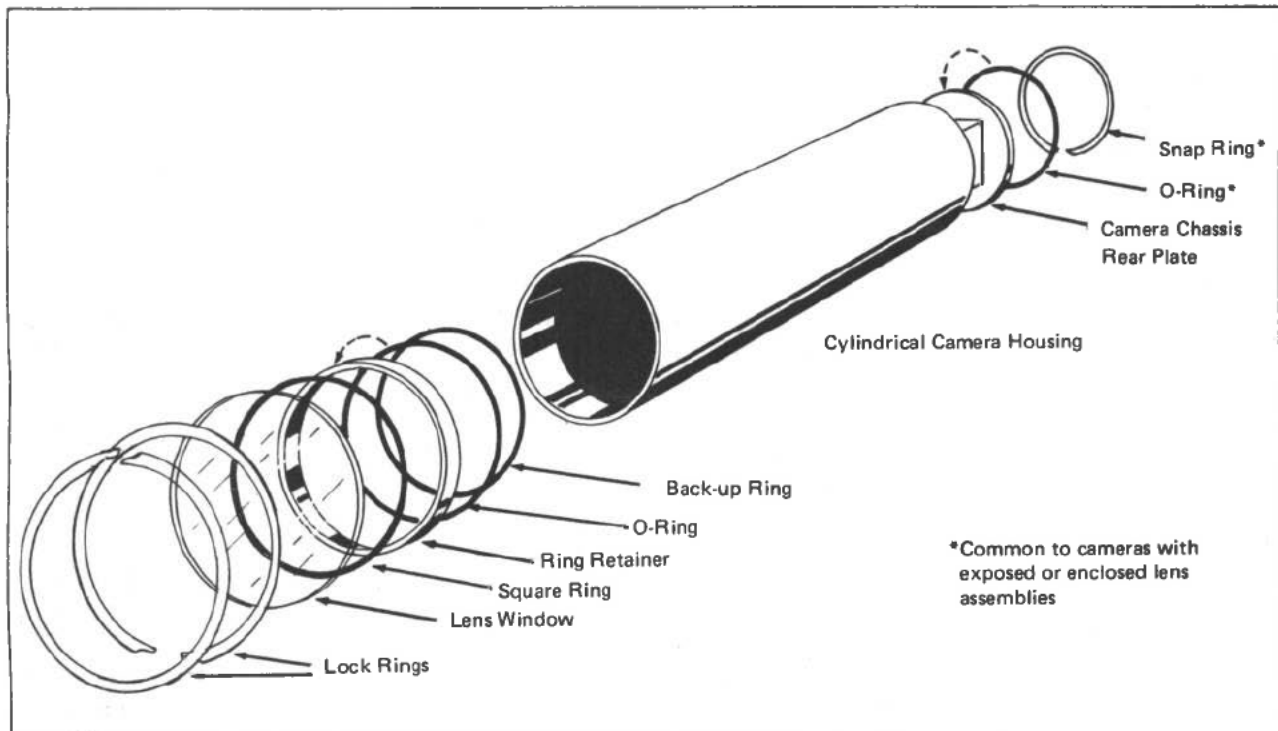


Figure 1-8. End Plate and Window Removed from Camera Barrel Housing.

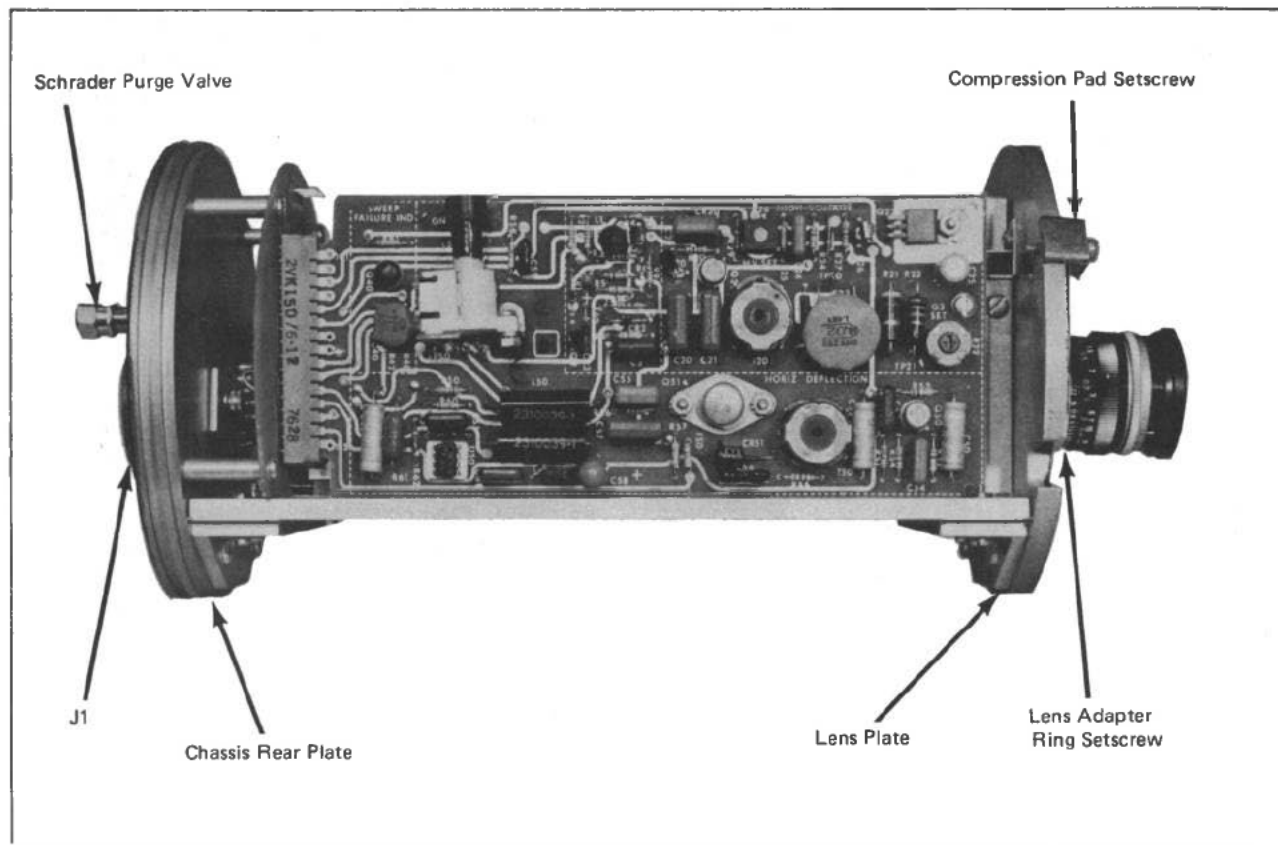


Figure 1-9. Interior View of Camera Showing Compression Pad Setscrew.

5. Locate threaded lens adapter ring installed in lens well. Loosen setscrew (Figure 1-9) locking adapter ring in place and remove ring from lens well by turning it counterclockwise.
 6. If needed, clean faceplate of vidicon and also exposed surfaces on lens that is to be installed in lens well. Do this cleaning with isopropyl alcohol or some other nonabrasive lens cleaner. Wipe dry with soft, lint-free cloth.
 7. Screw the lens into lens adapter ring until fingertight. Then, install both as a unit in lens well but do not tighten lens adapter ring setscrew yet. If lens is motor driven, plug its control cable into receptacle provided on camera chassis for this purpose.
- c. Put camera into operation as described in following paragraphs.

WARNING

110 ac line voltage is present on powered
VIDEO A2 and DEFLECTION A3 boards.

- d. If lens being installed has a fixed focal length, set focus ring on it at infinity, aim camera at an infinite distance scene with line details in it, and screw lens and lens adapter ring as a unit into the lens well to attain best resolution of details in picture at TV monitor. Then tighten setscrew for lens adapter ring to lock lens in position. If lens being installed is zoom type instead of fixed focal length, set lens for maximum focal length, aim camera at a far scene with line details, and adjust ring on lens for best resolution of line details in picture. Put ND filters in front of lens to cause lens iris to open fully. Zoom out to wide angle and loosen Allen setscrew on lens adapter ring (Figure 1-10). Screw zoom lens assembly in or out to achieve best focus. Lock down Allen screw on lens adapter ring, then zoom into narrow angle and set focus ring to best focus. Zoom out to wide angle and into narrow angle while watching scene target to recheck focus. Focus must remain sharp at any and all settings of focus range and zoom range. If not, retrack zoom lens by repeating this procedure step starting with placing ND filters in front of zoom lens. When tracking is completed, attach lens guard plate (Figure 1-10) to zoom lens assembly with machine screws.

NOTE

Before proceeding with next step, check the condition of the O-rings at the two ends of the camera chassis. Replace any of these rings that show deterioration. Also lubricate all of the O-rings with DC-11 silicon grease but apply it sparingly as too much grease will prevent proper seating. Do not substitute any other type of grease.

- c. If the camera is the enclosed lens type, install dry dessicant packs near lens assembly and slide camera chassis back into housing and toward front as far as chassis will go.
1. Aim camera at a scene and rotate housing as needed to keep picture at TV monitor from being tilted. Then, lock chassis into position by tightening

compression pad setscrew located on top edge of chassis front end vertical support (Figure 1-9).

2. Reinstall end plate and steel snap ring at rear end of camera (refer to **Figure 1-8**).
3. Reinstall glass window and steel snap lock rings at front end of camera (refer to **Figure 1-8**).

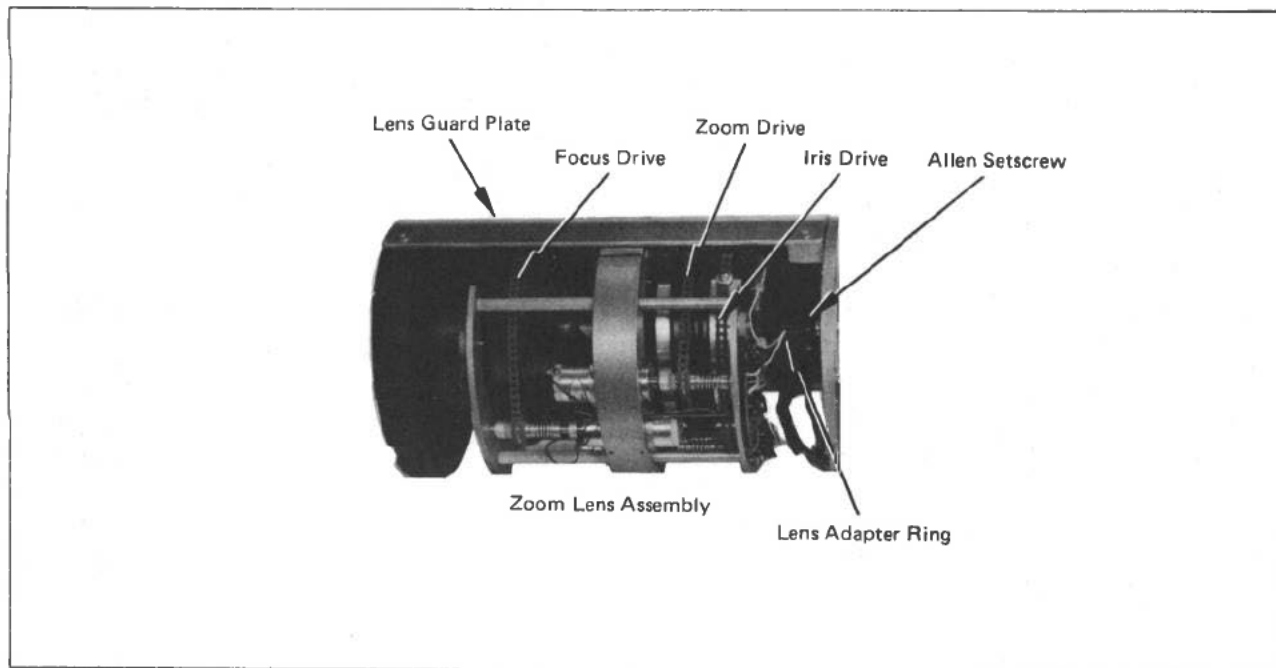


Figure 1-10. Zoom Lens Assembly

4. If desired, pressurize interior of camera with 5 or 10 pounds of dry nitrogen or air. Apply this nitrogen or air through the purge valve on the rear end of the camera.

1-13. OPERATING PROCEDURE

Except for iris and focus adjustments on the imaging lens at the front of the camera, all 7120/7210B Series Cameras are operated remotely from a 7900 Series Camera Control. Refer to the 7900 Series Camera Control Instruction Manual for operating procedure.

1-14. PROCEDURE FOR CHANGING ASPECT RATIO OF SCANNING PATTERN

Unless otherwise specified at time of purchase, 7120/7210B Series Cameras when shipped from the factory are set-up to have a scanning pattern with an aspect ratio of 4:3 width to height. Other aspect ratios, such as 1:1 or 3:4, can be attained by adjusting the height and width of the area scanned at the target in the image tube. However, it should be emphasized that a change of aspect ratio cannot always be made with a used vidicon, as the previously scanned and unscanned areas will have different sensitivities and dark currents.

The height of the scanning pattern is adjusted with a V. SIZE control and width with an H. SIZE control, both of which are located in the 7900 Series Camera Control. When making these adjustments, use first the one which is to increase a scanning dimension. In some cases scanning linearity may be adversely affected by these adjustments. Correct for vertical nonlinearity with the V. LIN control in the camera control, and correct the horizontal nonlinearity with the horizontal linearity control (L52) on the deflection board in the camera.

1-15. PROCEDURE FOR CHANGING SCAN RATE

7120/7210B Series Cameras are designed to operate at any horizontal line rate from 525 through 1225 lines/frame. However, some scan control adjustments may be required when changing from a low line rate to a high line rate, or vice versa. As shipped from the factory the camera is adjusted to operate at the line rate requested at time of purchase. The procedure to use when changing the line rate is as follows:

- a. Put camera into operation in a system.
- b. Adjust picture size and linearity (Paragraphs 2-12 and 2-13).
- c. If resultant picture at monitor is unsatisfactory, perform procedures outlined in Paragraphs 2-8 through 2-14.

7120/7210B SERIES
SECTION II
CAMERA MAINTENANCE

2-1 GENERAL CIRCUIT DESCRIPTION

A functional block diagram of the circuits in the 7120/7210B Series Camera is shown in Figure 1-2, Section I. An imaging lens at the front of the camera initially focuses light from scene being televised onto a photoconductive target located on the faceplate of an image tube. This light induces on the target an electrical charge pattern that is proportional to the scene brightness. By replenishing the charge deficiencies in this charge pattern with electrons from a beam that scans the target the light pattern is converted into a time sequence of current variations having a nominal amplitude of 300 nanoamperes peak-to-peak. At the video preamplifier section (described in Section III) these current variations are converted into proportional voltage variations having a peak-to-peak amplitude of about 200 millivolts. In television terminology the latter is called a video signal.

When the image tube in the camera is a vidicon the amplitude of the target signal current for a given light level is a function of a dc potential applied to the target. This feature allows camera sensitivity to be adjusted manually with a GAIN control on the 7900 Series Camera Control front panel, or automatically with an auto-target control circuit also located at the camera control unit.

The intensity of the electron scanning beam is a function of the dc potential on grid 1 of the image tube. This dc potential is adjustable with a BEAM control located at the 7900 Series Camera Control. In preliminary set up the BEAM control is set so just enough electrons are supplied by the beam to discharge the most highly illuminated areas of the target. If there is insufficient beam current a loss of detail contrast results in the picture. Too much beam current will reduce resolution and cause geometric distortion.

Any nonuniformity of the beam-landing angle at the target will cause undesirable shading patterns in the picture. This is counteracted in 7120/7210B Cameras by applying a dc potential of about + 950 volts to grid 4 of the image tube. The resulting effect is that a uniform decelerating electric field is introduced into the scanning beam path just before the beam reaches the target. This forces the beam into a trajectory that is almost at right angles to the target.

The electron beam scans the image tube target vertically at the rate of 60 Hz while simultaneously scanning it horizontally at a rate that can be anywhere in a range from 15,750 Hz to 30,705 Hz. Beam deflection is accomplished with two alternating magnetic fields. These fields occur at right angles to each other and result from sawtooth waveforms in a horizontal deflection coil and a vertical deflection coil. The amplitudes of these sawtooth current waveforms control the height and width of the scanning pattern on the target, and the dc level around which the waveforms alternate position the scanning pattern vertically and horizontally on the target. The circuits where the horizontal deflection coil current is generated and also the controls for adjusting its amplitude, linearity and dc level are located in the deflection module in the camera (Section IV), while the circuits that generate and control the dc level, linearity and amplitude of the current waveform in the vertical deflection coil are located at the 7900 Series Camera Control.

The scanning beam is focused so it converges to a point when it strikes the target. This focusing is done by introducing a magnetic field parallel to the axis of the image tube with a focus coil. The dc current for this focus coil is supplied from an adjustable source located in the video preamplifier module (Section III). For the focusing field to function properly, a specific dc potential is required on grid 3 of the image tube. The latter potential is set with a FOCUS control located at the 7900 Camera Control unit.

The active components in the camera, for the most part are installed on three printed circuit boards labeled video preamplifier, deflection, and filter (see Figure 2-1 through 2-3 for Model 7120 and Figure 2-4 through 2-6 for Model 7210B). Each of these printed circuit boards is bolted to the camera chassis with two or more screws, the removal of which makes it possible to reposition the board so repair or replacement of components can be done without completely removing the board from the chassis. Special care must be taken, however, to avoid damaging wires to other points in the camera. These particular wires must be unsoldered and disconnected if the board is to be removed completely from the camera.

2-2 MODEL 7120 CAMERA DISASSEMBLY

To make test points, internal adjustable controls and all other components inside the camera (Figure 2-1 thru 2-3) accessible for servicing:

- a. Remove from the top of the camera housing the screws along the back edge.

WARNING

Shock potentials as high as 1000 volts are exposed when the camera is out of its housing and operating.

- b. Pull the housing slightly toward the rear of the chassis and lift off.

2-3 MODEL 7210B CAMERA DISASSEMBLY

The active circuit components in 7210B series cameras are located on a metal framework chassis (Figure 2-4 thru 2-6) that slides out of the cylindrical camera housing from the back of the camera. Most of these active components are installed on three printed circuit boards which are secured to the metal chassis with machine screws. Prior to shipment from the factory, the interior of the cameras are pressurized with five to ten pounds of dry nitrogen. The nitrogen should be released through the purge valve on the back end of the camera before removing the chassis from the housing. To remove the chassis from the camera housing:

NOTE

In cameras having an enclosed lens, dessicant packs are used to maintain a dry atmosphere. These packs should be reactivated before the camera is resealed, since they deteriorate rapidly in the open air. To reactivate the dessicant packs, bake them for at least 12 hours at a temperature between 240° and 260° F.

- a. Disconnect camera from system.
- b. Using a straight-slot screwdriver for leverage, remove steel snap ring that retains back end plate in camera housing (Figure 2-7). If the camera has enclosed lens, remove steel snap ring that retains glass window in front of housing (refer to Figure 1-8).

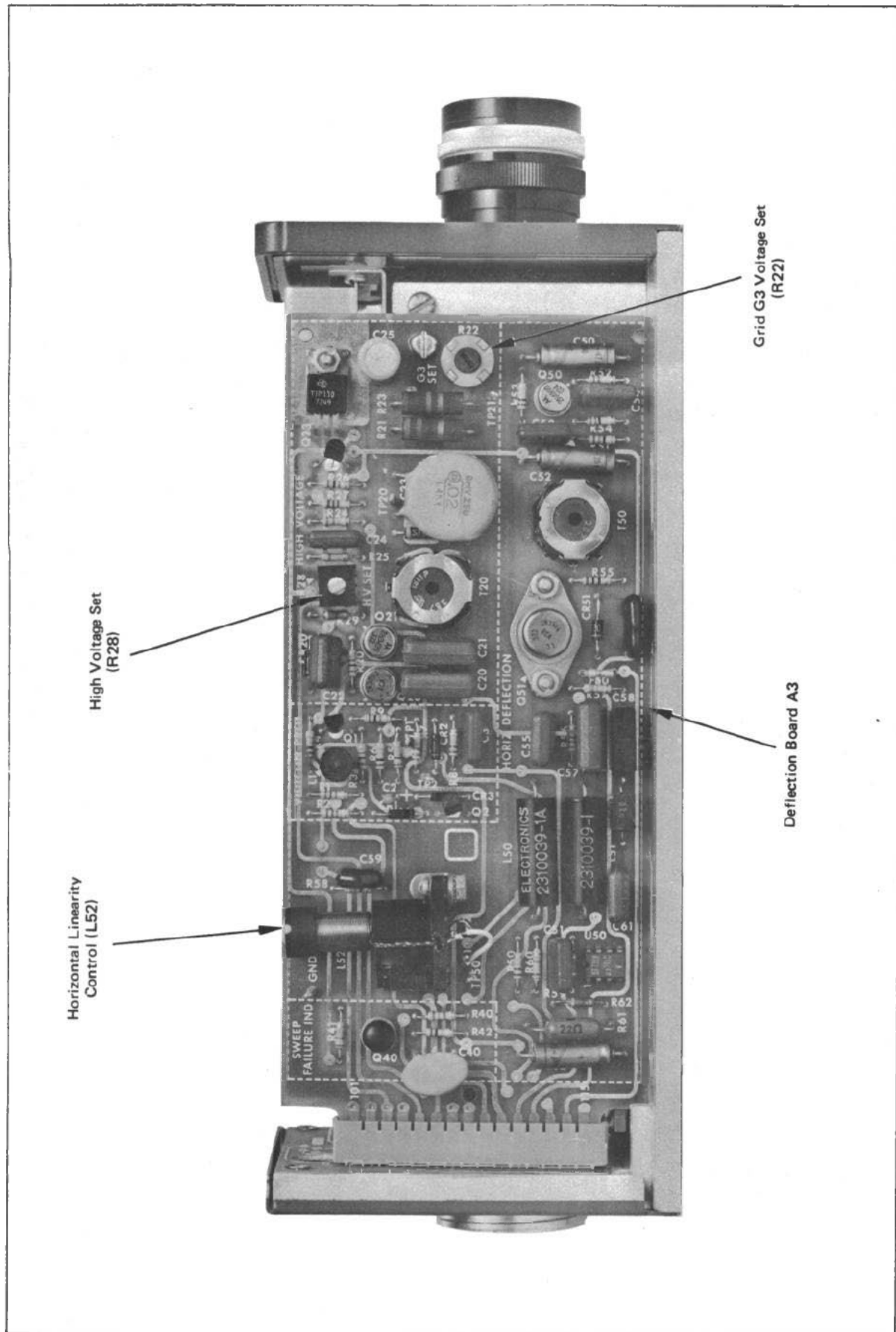


Figure 2-1. Interior View of 7120 Series Camera Facing Deflection Board A3

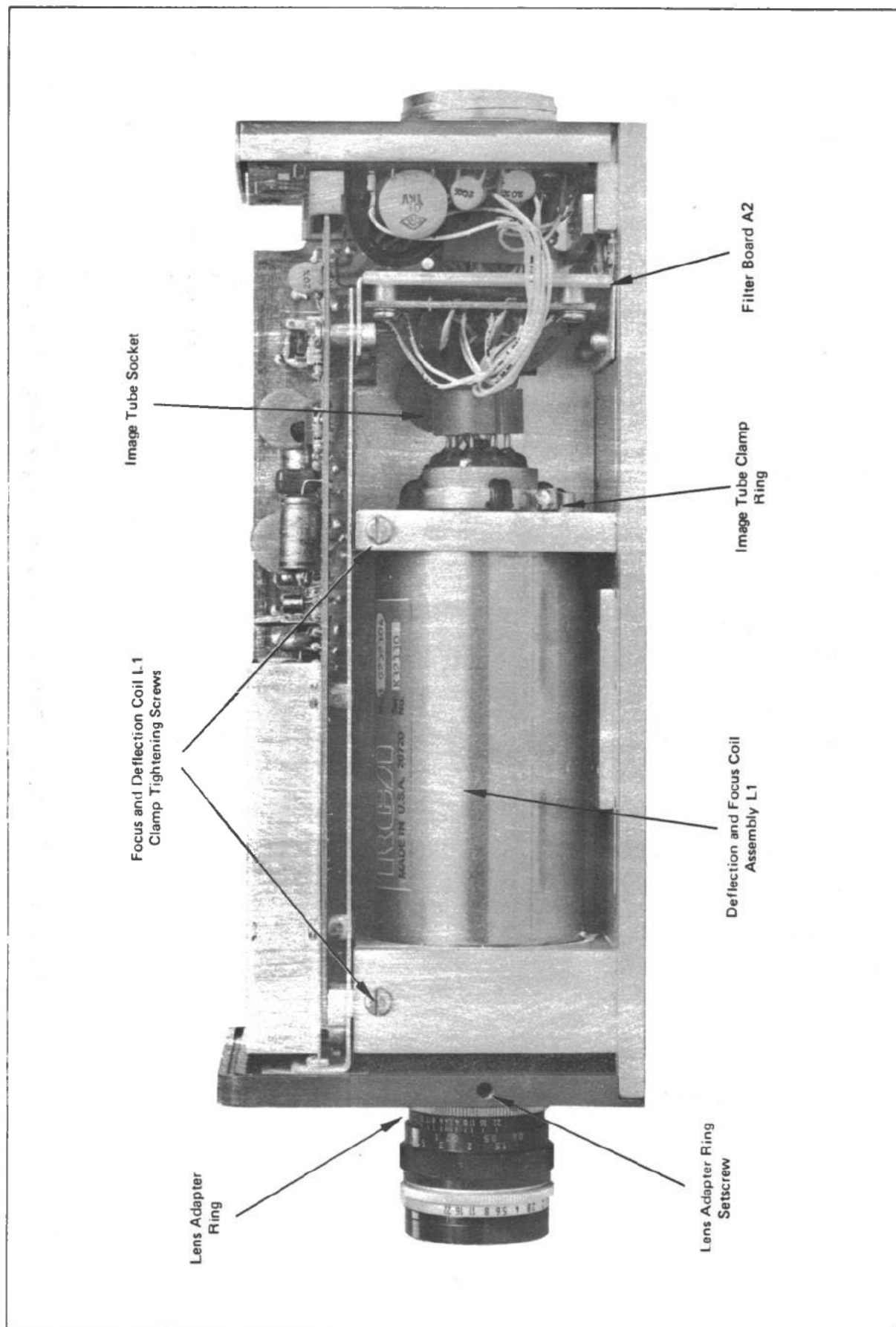


Figure 2-2. Interior View of 7120 Series Camera Facing Right Side.

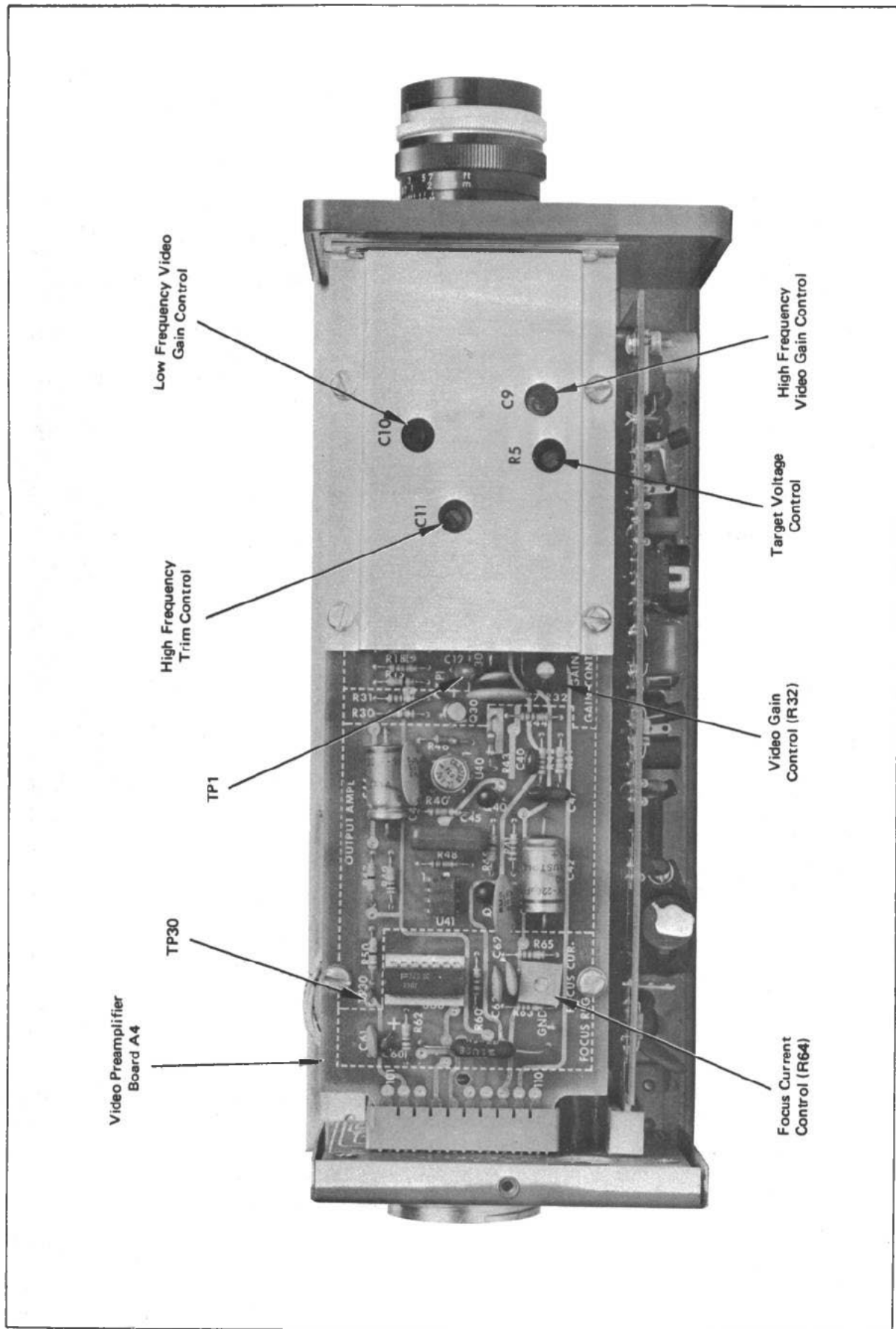


Figure 2-3. Interior View of 7120 Series Camera Facing Video Preamp Board A4

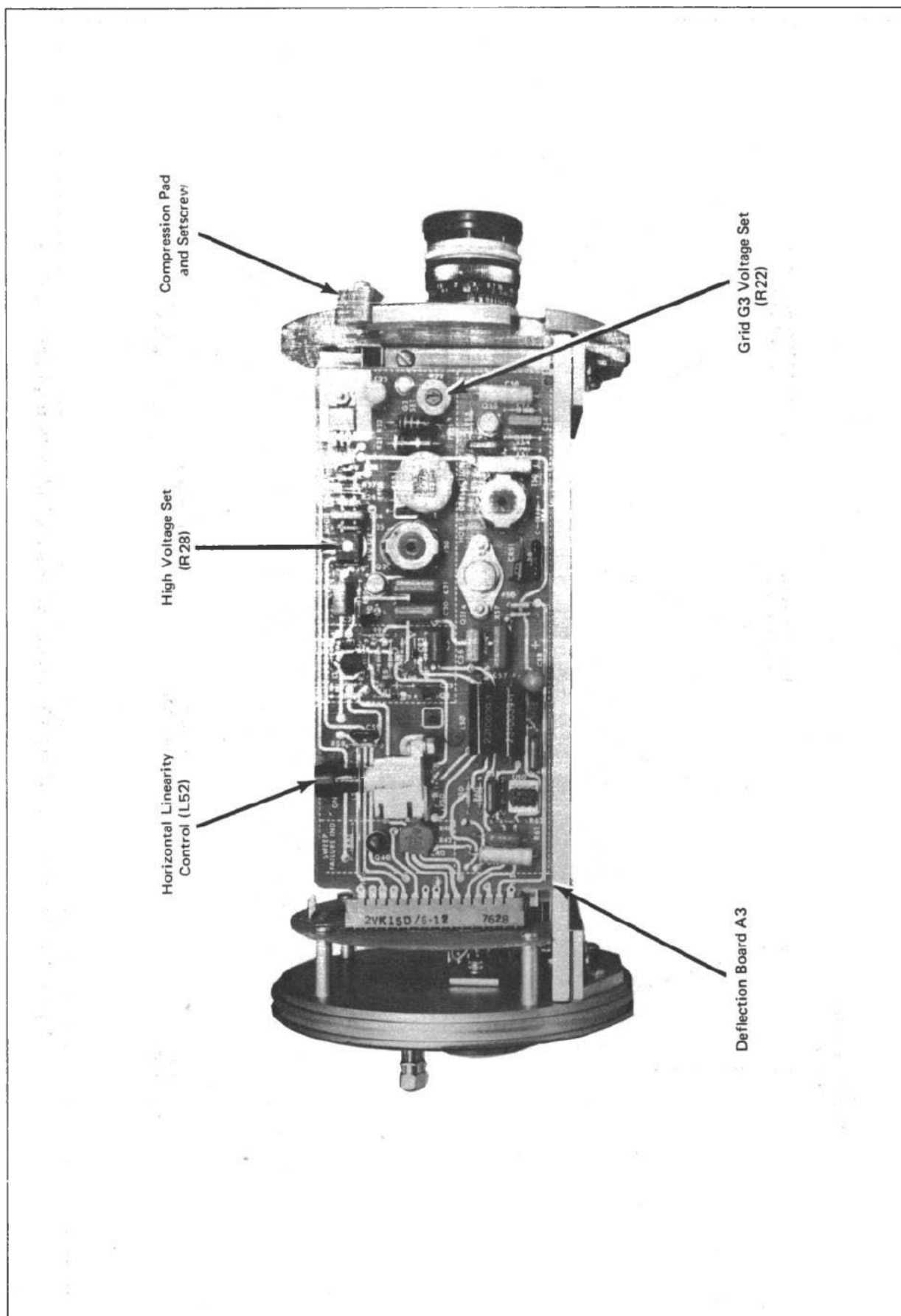


Figure 2-4. Interior View of 7210B Series Camera Facing Deflection Board A3.

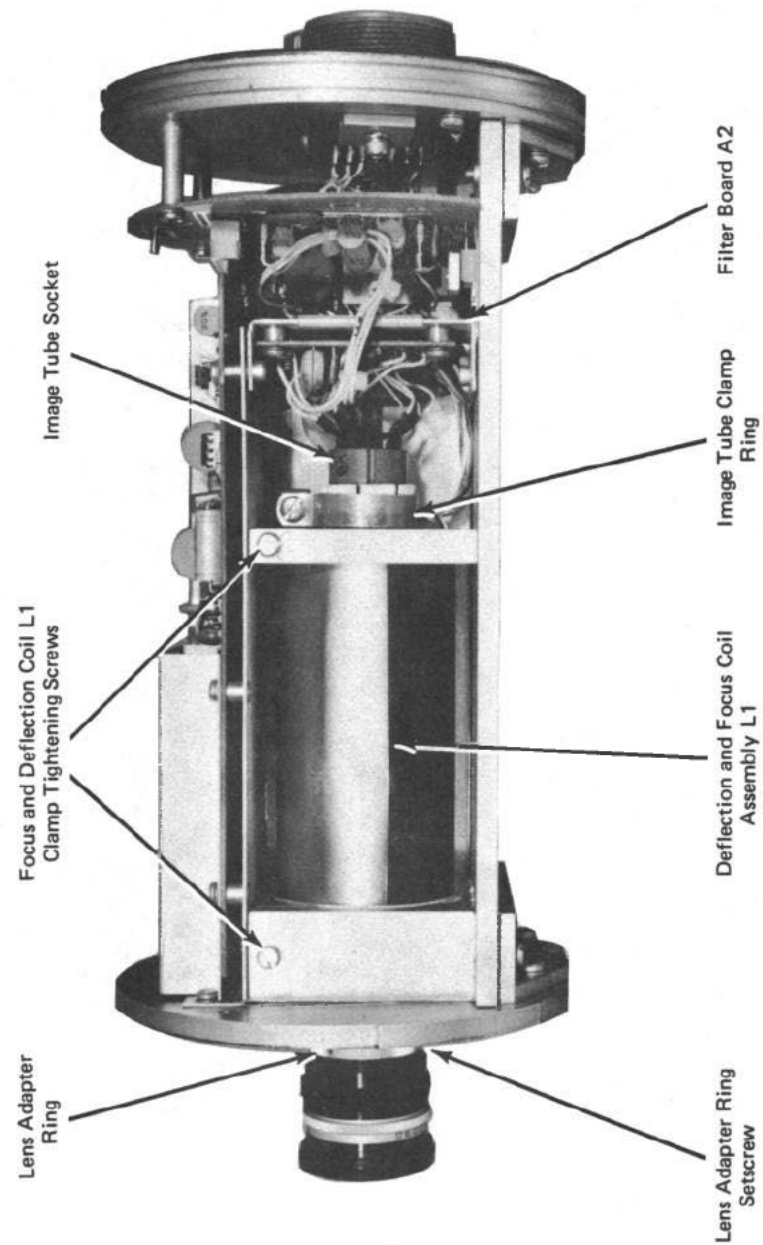


Figure 2-5. Interior View of 7210B Series Camera Facing Right Side.

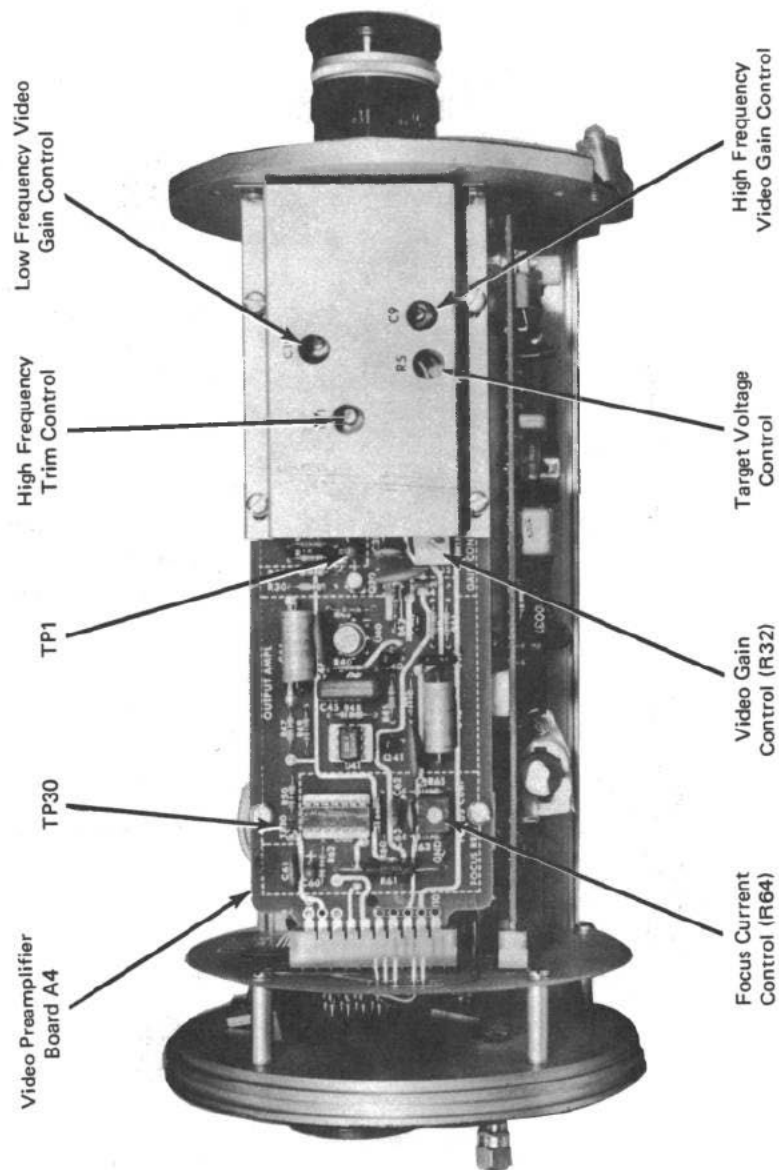


Figure 2-6. Interior View of 7210B Series Camera Facing Video Preamplifier Board A4

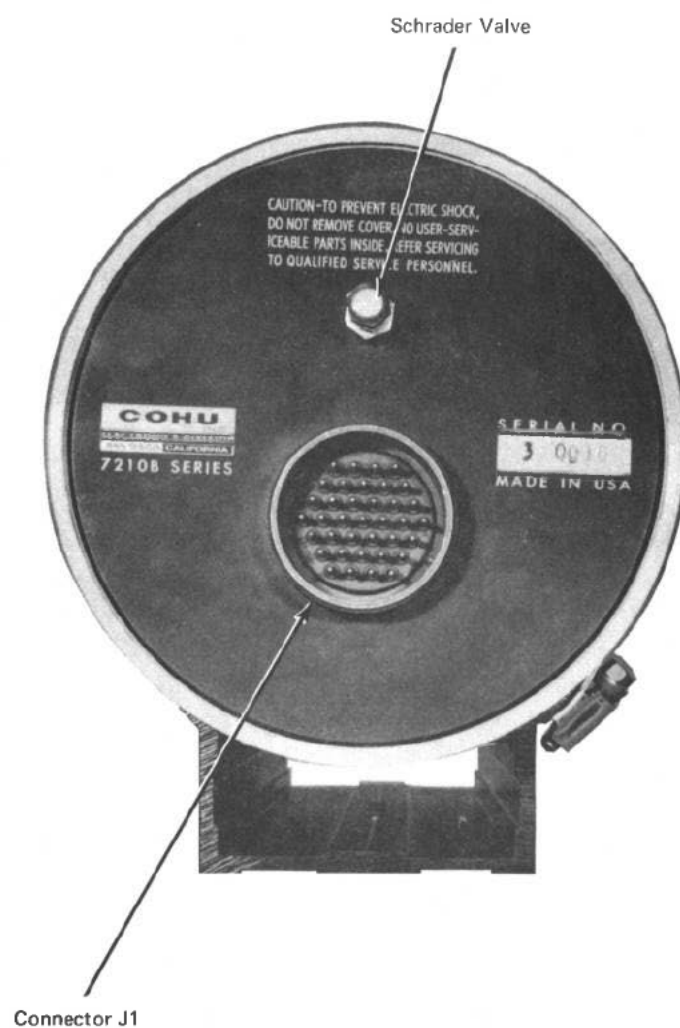


Figure 2-7. Typical 7210B Camera End Plate View

- c. Using hex wrench through opening at front of camera, loosen compression pad or pads setscrew located at the top edge of front vertical support for camera chassis (refer to Figure 2-4).

WARNING

Shock hazards as high as 1000 volts are exposed when camera is out of its housing and operating.

- d. Slide camera chassis out through opening at back of housing.
- e. After camera has been serviced, reinstall it into housing by reversing procedures in steps b through d and seal it as outlined in Paragraph 1-12, steps e1 - e4.

2-4. PREVENTIVE MAINTENANCE

Preventive maintenance required occasionally by the camera consists of cleaning the glass faceplate, lens surfaces and interior circuit areas (Paragraph 2-5), reactivating or replacing the dehumidifier in enclosed lens versions of the 7210B camera (Paragraph 2-6), replacing the image tube (Paragraph 2-7), and checking the settings of internal adjustable controls (Paragraph 2-8).

2-5. CLEANING

The interior circuit areas of the camera, the exposed glass surfaces on the lens, and the faceplate on the vidicon image tube should be cleaned periodically to prevent accumulation of dust and possible grime. Clean circuit areas with a soft bristle brush and a low-pressure air stream. Remove dust or grime from glass surfaces on the lens and from the faceplate of the vidicon image tube with lens tissue, isopropyl alcohol, or some other nonabrasive lens cleaner. Dry with a lint-free cloth. To reach the vidicon faceplate and circuit areas in enclosed lens cameras, the camera chassis must be removed from its housing. The procedure for this is in Paragraph 2-3.

2-6. MODEL 7210B DEHUMIDIFIER INSPECTION AND REPLACEMENT

7210B Cameras with an enclosed lens have dessicant packs inside their barrel housings on the camera chassis to maintain a dry atmosphere. A humidity-level indicator is also installed in a position that allows its inspection from the outside of the camera through the glass faceplate. This indicator may consist of a complete label bearing color spots or in cameras with a lens support that conceals the housing interior, only pieces of color spots may be used. The numbers 10, 20 and 30 on the color spots indicate the percentage of humidity required to change the color of the spot from blue to pink. When the spot marked "20" turns pink, internal camera humidity has reached 20%, indicating that the housing seal is not perfect. The point in the housing seal which is leaking should be repaired and the dessicant pack reactivated or replaced. Perform the following procedures to service the dessicant pack:

- a. Remove camera chassis from its housing, as outlined in Paragraph 2-3, steps a through d.
- b. Cut tape or loosen spring which secures dessicant packs to outside of deflection and focus coil assembly. Remove packs.

- c. As outlined in Paragraph 2-5, clean glass surfaces of the lens faceplate and vidicon image tube. Clean interior circuit areas if necessary.
- d. Reactivate dessicant packs or activate new packs (MIL-D-3464) and distribute contents uniformly throughout the envelopes. Then wrap envelopes around deflection and focus coil assembly and secure with spring.
- e. Place chassis in a warm dry oven at approximately 110° F for about 30 minutes or until all humidity indicators are blue.
- f. Immediately reinstall chassis in camera housing and seal as outlined in Paragraph 1-12 if preventive or corrective maintenance is not required.

2-7. MODEL 7120/7210B IMAGE TUBE REPLACEMENT

The usual indications of a defective vidicon are: (1) burned out filaments, (2) permanent raster burns, and (3) low cathode emission as evidenced by reduced camera sensitivity and poor shading and/or loss of detail contrast in picture. Use the following procedure to replace an image tube in a 7120/7210B series camera.

To Replace the Image Tube in a 7120/7210B Camera:

- a. Disconnect cable at rear of the camera and place the camera on a work bench.
- b. Take the electrical assembly out of the camera housing (Paragraph 2-2 for Model 7120 and Paragraph 2-3 for Model 7210B).
- c. Loosen the lens-adapter ring setscrew (Figure 2-2 for 7120 and Figure 2-5 for 7210B).
- d. Loosen the screw on the image tube clamp ring (Figure 2-2 for 7120 and Figure 2-5 for 7210B).
- e. Using the tool with the V-shaped end that is supplied with the camera, carefully unplug the tube socket from the base of the image tube while slowly and carefully forcing the image tube toward the front of the deflection yoke assembly.
- f. Slide the image tube completely out of the deflection yoke through the lens opening at the front of the camera and install the replacement image tube in its place.
- g. Seat the new image tube firmly in the deflection yoke assembly after rotating the tube so the short index pin on its base is at 3:00 o'clock, as viewed from the front the camera.
- h. Tighten the screw on the image tube clamp ring at the rear of the deflection yoke assembly, and then plug the tube socket onto the base of the image tube.
- i. Clean the faceplate on the image tube and the exposed faces of the imaging lens (Paragraph 2-5).
- j. Ensure that imaging lens is installed fingertight in lens-adapter ring. Install both as a unit in the lens opening at the front of the camera and then perform steps c2 - c4 of Paragraph 1-11 for Model 7120 or steps c and d of Paragraph 1-12 for Model 7210B.

- k. Focus the camera on a scene. If the picture at monitor is tilted from normal, loosen the deflection yoke assembly clamp-tightening screws (Figure 2-2 for 7120 and Figure 2-5 for 7210B) and rotate the deflection yoke assembly so the picture is properly oriented. Then retighten the screws. If the picture at the monitor cannot be brought into sharp focus with the lens on the camera, correct by adjustment of the FOCUS control on the front panel of the 7900 Series Camera Control. If the picture fails to fill out the monitor raster properly then perform the picture size and linearity adjustments outlined in Paragraphs 2-12 and 2-13.
- l. Reinstall camera in housing by reversing disassembly procedure in Paragraph 2-2 for Model 7120 or Paragraph 2-3 for Model 7210B.

2-8. INTERNAL ADJUSTMENTS

The 7120/7210B Cameras have 14 internal adjustable controls. Their functions and locations are listed in Table 2-1. Do not change the settings of these controls unless it has definitely been determined that the camera is not performing to specifications (Table 1-1, Section I). Any adjustments that are made must be done with the camera operating in a system with a 7900 Series Camera Control and a TV picture monitor that are known to be in good adjustment. Before making the adjustments allow 15 to 30 minutes for warm-up. The test procedures to use are in Paragraphs 2-9 through 2-15. The recommended test equipment is as follows:

- a. Calibrated wide-band laboratory oscilloscope that will respond accurately to video frequencies up to 35 MHz (Tektronix 547 with 1A1 Preamplifier and P6008 Low-Capacitor X10 Attenuator Probe, or equivalent).
- b. Sweep-frequency generator with 50 MHz sweep width, a 60 Hz sweep frequency, and an output signal of at least three volts p-p (Kay Electric "Marka Sweep" Video 154C, or equivalent).
- c. Vidicon simulator (Cohu VS-2, or equivalent) that will match the 75-ohm output of a sweep-frequency generator to the high target impedance of a vidicon.
- d. Camera test jig (Cohu CTJ-2, or equivalent) that is equipped with a 1600-line TV resolution chart and a RETMA TV Linearity Chart. In lieu of this test jig, the resolution and linearity charts at the back of the manual may be used; however, 1600 line resolution information on these paper charts may not be entirely accurate because of possible paper shrinkage or printing limitations.
- e. High-impedance voltmeter (100 kilohms/V) with accuracy of 2% or better and dc measuring capability down to 20 millivolts and up to 1500 volts dc.
- f. Dot bar generator designed for testing linearity of 525 through 1225-line television systems (Cohu 2380 series, or equivalent).
- g. High-resolution television monitor with same scanning pattern as camera (Conrac QQA Series, or equivalent).

Table 2-1. Internal Adjustable Controls, 7120/7210B Series Cameras.

LOCATION	NAME	FUNCTION
Lens well at front end of camera (Figure 2-2)	Lens adapter ring	Adjusts distance between image tube target and imaging lens at front of camera
Behind front end plate of camera (Figure 2-2)	Deflection coil assembly	Can be rotated to adjust orientation of scanning pattern on image tube target
Video preamplifier board A4 (Figure 2-3)	Target voltage control (R5)	Adjusts dc potential on image tube target
	High frequency gain control (C9)	Sets high-frequency response of video preamplifier
	High frequency trim control (C11)	Adjusts over a narrow trim range the high-frequency response of the video preamplifier
	Low frequency gain	Sets low-frequency response of video preamplifier
	Video gain control (R32)	Sets video gain
	Focus current control (R64)	Sets level of dc current in focus coil at image tube
	Target voltage control	Sets voltage on image tube target if image tube is the lead-oxide or silicon diode array type
	OTHER - VIDICON jumper	Selects source of target voltage for the image tube in the camera. If the image tube is a vidicon, the jumper is located in the VIDICON position and the target voltage is controlled with an auto-target circuit in the 7900 Camera Control or it is set at a fixed level with a TARGET control, also located in the camera control unit. If the image tube is the lead-oxide or silicon diode array type, the OTHER -

Table 2-1. Internal Adjustable Controls, 7120/7210B Series Cameras.

LOCATION	NAME	FUNCTION
		VIDICON jumper is located in the OTHER position and the target voltage is set at a fixed level with R5 on the video pre-amplifier board
Deflection board A3 (Figure 2-1)	Horizontal Linearity (L52)	Adjusts linearity of horizontal scan
	+700 volt adjust (R22)	Sets level of dc potential on grid of G3 of image tube
	+1000 volt adjust (R28)	Sets level of dc potential on grid 4 of image tube

2-9

TARGET VOLTAGE ADJUSTMENT PROCEDURE**NOTE**

If the image tube in the camera is a vidicon, the VIDICON - OTHER jumper on the video preamplifier board must be in the VIDICON position. For any other type of image tube the jumper must be in the OTHER position.

- a. Put camera into operation in a system and cover lens at front with a light-proof cap.
- b. If the image tube in the camera is a vidicon, set AUTO - MAN switch on 7900 Series Camera Control front panel to the MAN position. Then set TARGET control on vidicon processor board in the camera control so vidicon dark current produces a voltage drop of 20 millivolts across R1 on the video preamplifier board on the camera.
- c. If the image tube in the camera is a lead-oxide type, set R5 on the video pre-amplifier board so the dc potential on the image tube target is that specified by the manufacturer of the tube. If specified voltage is unknown set at +45 volts.
- d. If the image tube in the camera is the silicon diode array type, set R5 on the video preamplifier board so the dc potential on the target of the image tube is that specified by the tube manufacturer. If the specified voltage is unknown, set at +8 volts.

2-10.

VIDEO BANDWIDTH AND GAIN ADJUSTMENTS

- a. Unscrew and remove lens from front of camera and replace it with a vidicon simulator (Paragraph 2-8). Ensure that the high-impedance output of the simulator is in good contact with the target ring on the end of the image tube.
- b. Apply signal from the 75-ohm output of a sweep-frequency generator (Paragraph 2-8) to the low-impedance input of the simulator. Set sweep width of the signal at 50 MHz set sweep rate at 60 Hz, and set sweep signal amplitude at 0.450 volt peak-to-peak (1.0V rms minus 16 dB).

- c. At the 7900 Series Camera Control: set internal BEAM control on power supply board fully counterclockwise to turn off the scanning beam at image tube; set TGT switch on front panel to MAN; set GAIN and BLANK switches on front panel fully CCW; and set PWR switch on front panel to ON.
- d. Using an oscilloscope with a low-capacity X10 attenuator probe (Paragraph 2-8), monitor the video output signal of the camera at TP30 (Figure 2-3) on the video preamplifier board.
- e. Set C9, C10 and C11 (Figure 2-3) on the video preamplifier board for flattest frequency response out to 32 MHz.
- f. If camera is to be operated with AUTO-MAN jumper on video preamplifier board in the MAN position, set R32 (Figure 2-3) so the amplitude of the video signal is 0.2 volt peak-to-peak in the low-frequency region at TP30 on the video preamplifier board.

NOTE

The final response should deviate no more than ± 0.1 dB/MHz up to 32 MHz.

2-11. FOCUS ADJUSTMENTS

To adjust scanning beam in image tube for best focus:

- a. Install camera on a camera test jig (Paragraph 2-6) facing a back-illuminated 1600-line TV resolution test pattern. If such a test jig is unavailable, remove the 1600-line resolution chart at the back of this manual and hang it on a wall. Position the camera so it sits horizontal and points at the resolution chart with the lens optical axis coaxial with an imaginary vertical line through the center of the chart. The correct distance to use from the center of the lens to the chart depends on focal length of the lens and can be computed with following formula:

Lens-to-Test Pattern Distance = Lens Focal Length x Width of
Test Pattern x 2, where all
measurements are in inches.

NOTE

The focal length of some lenses may vary several percent from the labeled value. Also, the correct distance to use from lens to chart will depend somewhat on the thickness of the lens, and some lenses may not focus ideally at distances as close as specified in this chart. Also any aberrations in the lens will be magnified. This is especially true of lenses with a short focal length. Therefore, if geometric distortion or resolution, particularly corner resolution for large lens apertures, is unsatisfactory, an unproven lens may be a contributing factor.

- b. Put the camera into operation in a system using the operating procedure in the

7900 Series Camera Control Instruction Manual. Adjust for best reproduction of TV resolution chart possible on the TV monitor raster.

- c. Set FOCUS control at 7900 ~~Series Camera Control~~ fully clockwise.
- d. At deflection board in camera (Figure 2-1) measure the dc voltage at TP20 and adjust to $+7000 \text{ volts} \pm 5\%$ with R28. At the same subassembly measure the dc voltage at TP21 and set at $+700 \pm 5\%$ with R22; then set FOCUS control at 7900 Series Camera Control front panel to the center of its range.
- e. At video preamplifier subassembly (Figure 2-3) set focus current control R64 for best resolution of tapered lines in vertical wedges of test pattern image on TV monitor raster. Adjust the GAIN and BLANK controls on front panel of the camera control as needed to maintain a good picture. If picture will not focus satisfactorily, check that distance between lens and target in image tube is correct (Paragraph 1-11, steps 1 through 4).

2-12. PICTURE SIZE AND CENTERING ADJUSTMENTS

With camera set up for operation as in steps a and b of Paragraph 2-9:

- a. Overscan image on target of image tube (make display on monitor raster smaller) by adjusting the HORIZONTAL SIZE, VERTICAL SIZE, HORIZONTAL CENTERING and VERTICAL CENTERING controls at 7900 Series Camera Control until circular image of target is displayed on monitor raster.
- b. Position camera so resolution test pattern is centered on target.
- c. Readjust the HORIZONTAL SIZE, VERTICAL SIZE, HORIZONTAL CENTERING and VERTICAL CENTERING controls until the points of arrows at edges of test pattern are flush with the edges of the monitor screen.

2-13. SCAN LINEARITY ADJUSTMENTS

- a. Install a dot bar generator (Paragraph 2-6) in the video line between the video output terminal of the 7900 Series Camera Control and the video input of the TV monitor. Adjust the controls on the dot bar generator so 14 rows and 17 columns of dots are displayed on the monitor raster.
- b. Set up camera for operation as in steps a and b of Paragraph 2-9, but replace TV resolution chart with a RETMA Linearity Chart (Paragraph 2-6). Use the linearity chart in the back of this manual if a back-lighted one on a test jig is not available. Aim the camera so the linearity chart is superimposed on the dot pattern at the monitor. If linearity chart image on monitor raster is tilted with respect to the dot pattern, correct as instructed in Paragraph 2-12.
- c. Adjust the horizontal linearity control on the deflection board in the camera (L52, Figure 2-1) and the VERTICAL LINEARITY control on the deflection board in the 7900 Series Camera Control to make all dots fall within their corresponding circles. If needed, readjust the HORIZONTAL SIZE and VERTICAL SIZE controls on the

deflection board at the camera control to keep the raster at the monitor filled out with the test pattern. Geometric distortion will be within $\pm 1\%$ if the centers of all dots can be made to fall within their corresponding circles. If any dot touches the annulus of its circle, the geometric distortion will be within $\pm 2\%$. The geometric distortion will be greater than 2% if any dots are outside their circles.

2-14. ADJUSTMENT FOR TILTED SCANNING PATTERN

If the picture produced at a TV monitor with the camera signal is tilted from normal:

- a. Loosen the two screws (Figure 2-2) that tighten the clamp around the focus and deflection coil assembly (L1).

WARNING

Shock potential as high as 1000 volts is present at the base of the image tube.

- b. While observing results at TV monitor, rotate deflection coil (L1) so picture is oriented properly.
- c. Retighten the two screws on the clamp that locks the deflection coil assembly in place.

2-15. CORRECTIVE MAINTENANCE

When performing corrective maintenance:

- a. Use extreme care in placing test probes on test points, otherwise damage to semiconductors may result.
- b. Replace defective components with ones known to be in good condition.
- c. Turn off power before doing any soldering, preferably by disconnecting the system from its ac power source.
- d. Whenever soldering or unsoldering use a well-tinned soldering iron having the lowest power rating that will do the job.
- e. Avoid overheating etched-circuit paths or semiconductor leads while soldering or unsoldering. Where practical, use a heat sink on semiconductor leads.

In the event a malfunction occurs, first check for good external cable connections and give the interior of the camera a thorough visual inspection. If these fail to uncover the cause of the trouble then use as a general troubleshooting guide the information listed in Table 2-2. To use this table first consult the column headed "SYMPTOM" until an observed condition is recognized. Then consult the corresponding entries in the two right-hand columns for the probable cause and where to look for it. Some troubles might arise that will necessitate dc or ac voltage measurements and signal tracing. These should be with a high-impedance voltmeter and laboratory-quality oscilloscope having a low-capacity $\times 10$ attenuator test probe. The waveform or voltage level that should be present at each connector terminal can be determined by referring to Table 1-1, Section I, or to the section of

the manual where the particular module that generates or uses the waveform is described (Section III and IV). Any test points or components that are located on video preamplifier board (A4) or deflection board (A3) or filter board (A4) can be located using Figure 2-4 through 2-6 as guides.

2-16. REPLACEMENT PARTS

Replacement parts that can be ordered from Cohu or any of its sales representatives for the 7120 and 7210B Series Camera main assembly are listed in Table 2-3. Replacement parts for filter board (A2) are listed in Table 2-4.

2-17. SCHEMATICS

The overall wiring diagram for the 7120 and 7210B Series Cameras and a schematic for filter board (A2) is in Figures 2-7 and 2-8 respectively. The schematic for video preamplifier board (A2) is in Section III and the schematic for deflection board (A3) is in Section IV.

Table 2-2. Troubleshooting Chart

SYMPTOM	PROBABLE CAUSE	CHECK
No picture at TV Monitor	Beam not scanning target at image tube	Setting of BEAM CURRENT control on video processor board in 7900 Series Camera Control
		Image tube protection circuit on deflection board (Section IV)
		Regulated high-voltage supply on deflection board (Section IV)
	High voltages absent or incorrect at focus and field-mesh grids (G3 and G4) of image tube	Regulated high-voltage supply on deflection board (Section IV)
	Target voltage too low at image tube	Setting of target-voltage control (Paragraph 2-7)
	No filament voltage or filament burned out at image tube	For 6.3 volts dc between pins 1 and 8 at tube socket. If voltage is present and filament is not glowing, check continuity of tube filament

Table 2-2. Troubleshooting Chart (cont.)

SYMPTOM	PROBABLE CAUSE	CHECK
No picture at TV Monitor	Poor cable connection or open circuit in cable	For bad connections at camera-to-camera control cable receptacles. Also check wires in cable for continuity
	Defective video amplifier stage	Video preamplifier (Section III)
Faint picture or poor contrast between blacks and whites	Insufficient video gain	Setting of R32 on video preamplifier board or setting of TARGET control at 7900 Series Camera Control. If gain is being automatically controlled, check auto-target circuit on video processor board in 7900 Series Camera Control
Faint picture or poor contrast between blacks and whites	Incorrect amplification of video signal	Video preamplifier (Section III)
	Incorrect bias on image tube cathode	Image tube protection circuit on deflection board (Section IV)
	Low target voltage	Setting of target voltage control (Paragraph 2-7)
	Weak image tube	VI (Figure 2-2)
Snowy picture	Defective video amplifier stage	Video preamplifier (Section III)
	Wrong video output polarity selected	Position of POLARITY jumper on video processor board at 7900 Series Camera Control
Picture tilted	Incorrect orientation of deflection and focus coil subassembly	Reposition coil assembly as instructed in Paragraph 2-12
Picture not completely filled out from top to bottom	Vertical deflection signal amplitude too low	Settings of VERTICAL SIZE control on deflection board in 7900 Series Camera Control

Table 2-2. Troubleshooting Chart (cont.)

SYMPTOM	PROBABLE CAUSE	CHECK
	Defective deflection coil	For open circuit or shorted turns in vertical winding of deflection coil assembly (L1) (Figure 2-2)
Picture not centered	Horizontal or vertical centering control out of adjustment	Setting of HORIZONTAL CENTERING or VERTICAL CENTERING control on deflection board in 7900 Series Camera Control
Picture compressed at top	Vertical linearity control out of adjustment	Setting of VERTICAL LINEARITY control on deflection board in 7900 Series Camera Control
	Horizontal deflection waveform incorrect	Horizontal deflection waveform generator (Section IV)
Picture fuzzy	Picture out of focus on image tube target	Setting of FOCUS control on front panel of 7900 Series Camera Control
		Setting of focus ring on lens
		Position of lens adapter ring (Paragraph 1-11)
		Setting of magnetic FOCUS control on video preamplifier board (Paragraph 2-9)
	Deflection focus coil current regulator	Magnetic focus regulator on video preamplifier board (Section III)

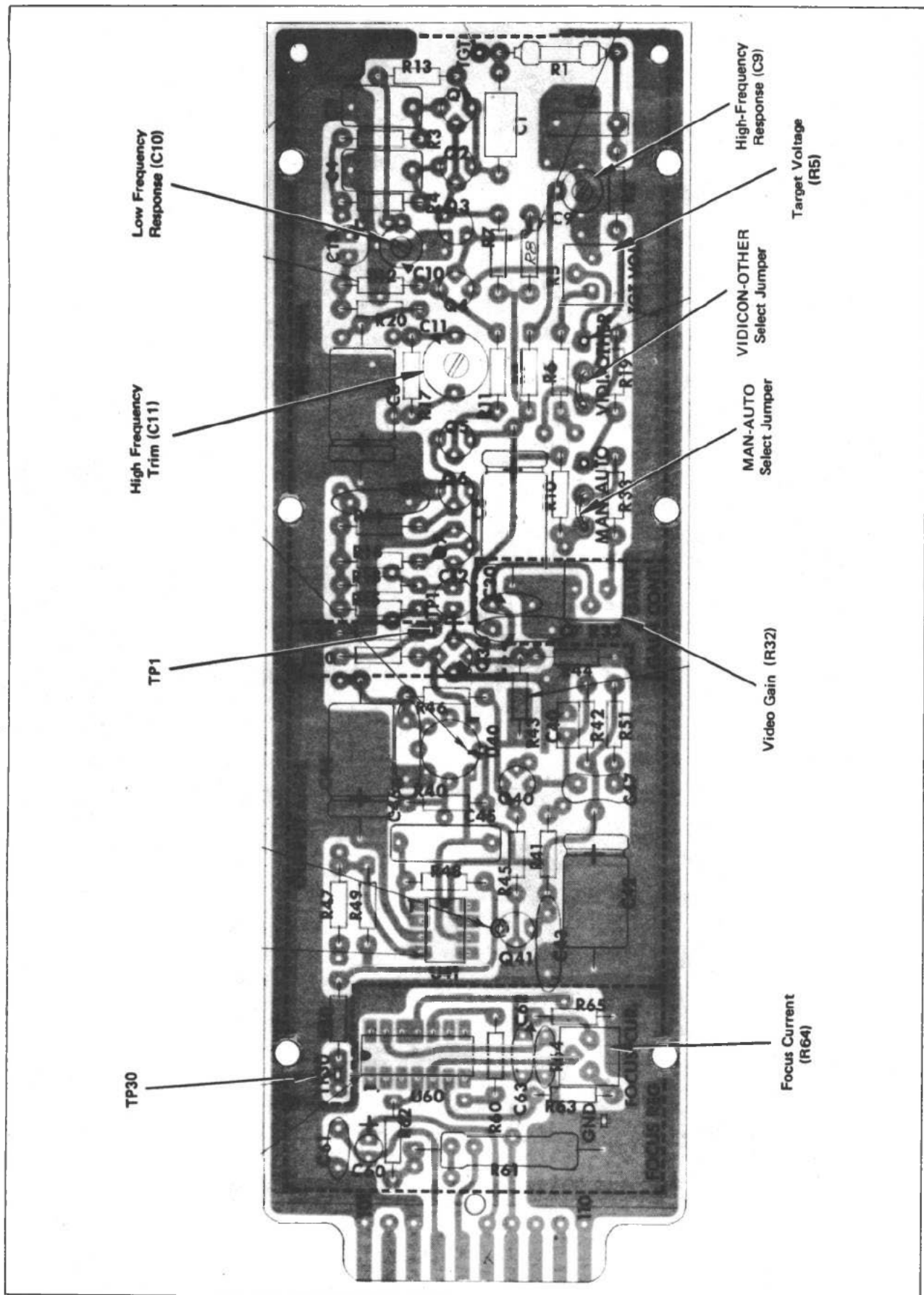


Figure 2-8. Component Locations, Video Preamplifier Module A4

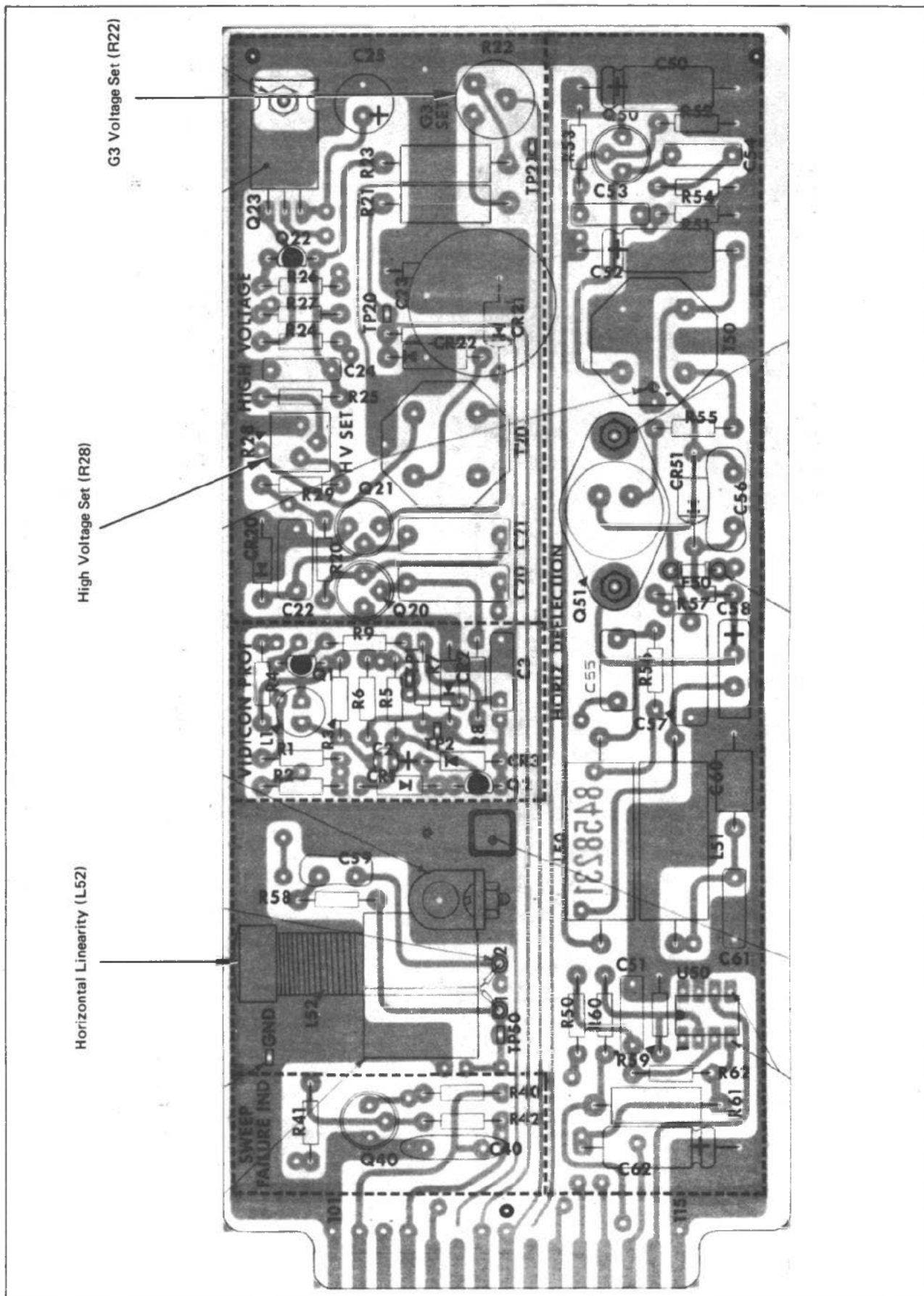


Figure 2-9. Component Locations, Deflection Module A3

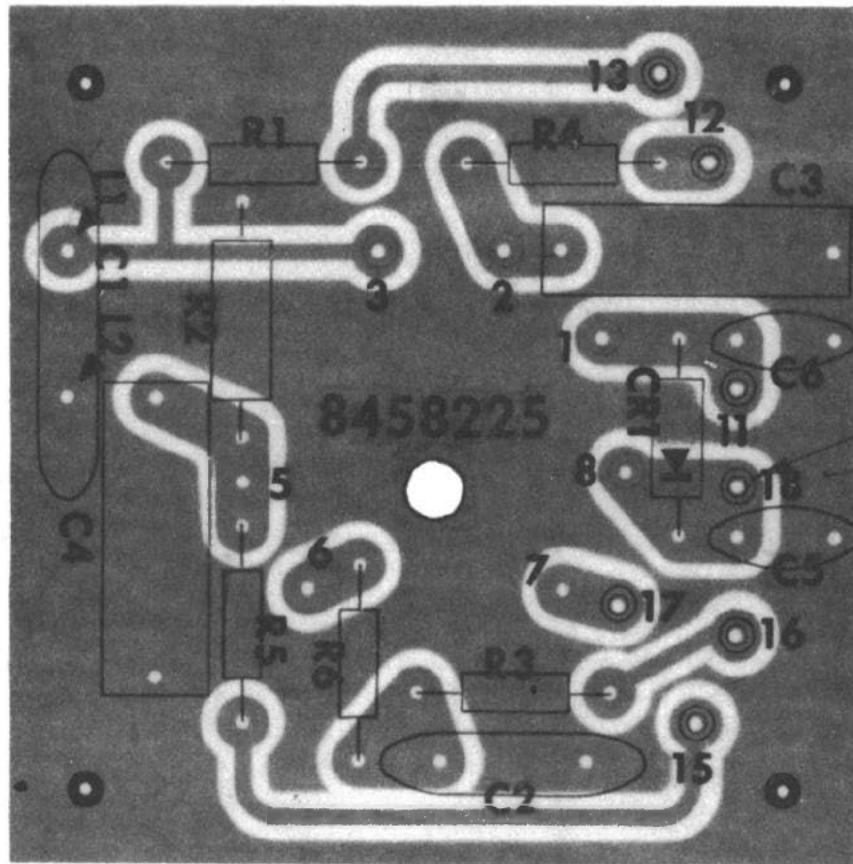


Figure 2-10. Component Locations, Filter Board Subassembly A2.

Table 2-3. Replacement Parts for Model 7120/7210B Main Camera Assembly

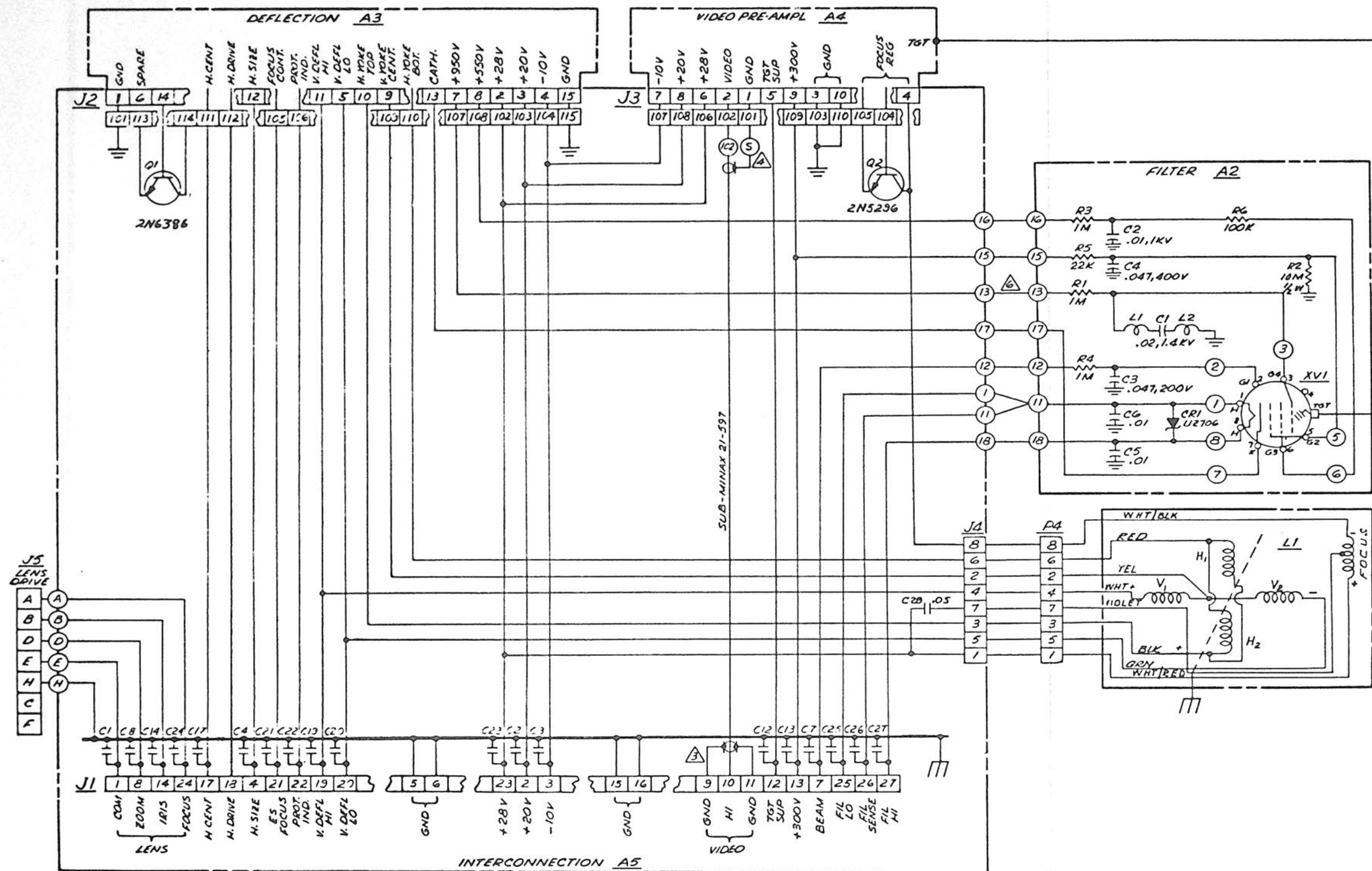
REF DES	DESCRIPTION	COHU PART NUMBER
	<u>CIRCUIT BOARDS</u>	
A2	Filter board A2 Assembly	8458225-001
A3	Deflection board A3 assembly	8458231-001
A4	Video preamp board A4 assembly	8458241-001
A5	Interconnection board A5 assembly	8458251-001
	<u>CAPACITORS</u>	
	NOTE: All capacitor values are listed in microfarads unless otherwise specified.	
C1 thru C4	.01 @ 50V, ceramic	0410009-103
C5, C6	Not used	
C7	.01 @ 1,000V, line by-pass	0410013-004
C8	.01 @ 50V, ceramic	0410009-103
C9 thru C11	Not used	
C12	.01 @ 50V, ceramic	0410009-103
C13	.01 @ 1,000V, line by-pass	0410013-004
C14	.01 @ 50V, ceramic	0410009-103
C15, C16	Not used	
C17	.01 @ 50V, ceramic	0410009-103
C18	Not used	
C19 thru C27	.01 @ 50V, ceramic	0410009-103
C28	.05 @ 50V, ceramic	0410009-503
	<u>COILS & INDUCTORS</u>	
L1	Focus and deflection coil assembly	8458212
	<u>TRANSISTORS</u>	
Q1	Type 2N6386	7210113-001
Q2	Type 2N5296	7210009-002

Table 2-4. Replacement Parts for Filter Board A2 (cont.)

REF DES	DESCRIPTION	COHU PART NUMBER
	<u>CAPACITORS</u>	
	NOTE: All capacitors values are in microfarads unless otherwise specified.	
C1	.02 @ 1,400V	0410013-001
C2	.01 @ 1,000V	0410013-004
C3	.047 @ 200V	0610133-015
C4	.047 @ 400V	0610133-016
C5, C6	.01 @ 50V	0410009-103

Table 2-4. Replacement Parts for Filter Board A2 (cont.)

REF DES	DESCRIPTION	COHU PART NUMBER
CR1	<u>DIODES</u>	
CR1	Type UZ706, Zener	3510062-001
	<u>COILS</u>	
L1, L2	.118 henry shielding bead	4910020-001
	<u>RESISTORS</u>	
	NOTE: All resistors are carbon whose values are listed in ohms, ±5% tolerance, and ¼ watt rating unless otherwise specified.	
R1	1M	4010025-105
R2	10M, ½ watt	0310030-106
R3, R4	1M	4010025-105
R5	22k	4010025-223
R6	100k	4010025-104



- △ LEAD FROM A5-13 TO A2-13 TO HAVE 1KV INSULATION.
 5. ALL CAPACITORS ON A5 ARE .01 MICROFARADS, C7 & C13 ARE 1KV.
 △ SINGLE FORWARD SHIELD AT A5- PER MM-1.
 △ DUAL FORWARD SHIELD AT J1 PER MM-1.
 2. ALL CAPACITORS ARE IN MICROFARADS.
 1. ALL RESISTORS ARE IN OHMS, 1/4W, ±5%.
- NOTES: UNLESS OTHERWISE SPECIFIED**

Figure 2-11. Wiring Diagram, Model 7120 Series Camera (Dwg. D8458200D)

SECTION III

VIDEO PREAMPLIFIER MODULE A4

3-1. GENERAL DESCRIPTION

Video preamplifier module A4 is a printed circuit board assembly that is located in the 7120 Camera where shown in Figure 2-3, Section II. In the module, signal current from the image tube is converted into a video voltage signal and then amplified. A regulated dc current is also produced for the focus coil at the image tube.

3-2. INPUTS AND OUTPUTS

Signals and supply voltages that enter or exit at interface terminals of the video preamplifier are described in Table 3-1.

Table 3-1. Inputs and Outputs, Video Preamplifier Module A4

Input Power — +300 volts dc (terminal 19) +28 volts dc (terminal 6) +20 volts dc (terminal 8) -10 volts dc (terminal 7) Input Signals — Target current (TGT terminal): Nominal 300 nanoamperes p-p Target supply (terminal 5): Variable dc potential in range from about +5 to +60 volts Output Signals — Video (terminal 2): 200 milliamperes p-p Focus current (terminal 3): Nominal 80 milliamperes dc	
--	--

3-3. CIRCUIT DESCRIPTION

Refer to schematic at end of section. The circuits in the video preamplifier module include a video preamplifier, a video output amplifier and a focus current regulator, as shown by block diagram in Figure 3-1.

Via resistors R2 and R1, a dc potential set with potentiometer R5 (if image tube in camera is the lead-oxide or silicon diode array type) or supplied from the 7900 Series Camera Control (if image tube is a vidicon) controls the target voltage of the image tube. The target voltage enables the scanning beam to generate a signal current that varies with scene illumination in the range from zero to about 300 nanoamperes peak-to-peak. In the video preamplifier module this current is converted into a video voltage signal by a negative-feedback, low-noise, wide-band operational amplifier formed with transistors Q1 through Q7 the low-frequency response of this amplifier is adjustable with C10 and the high-frequency response with C11 and C9. These controls are set so the amplifier gain is flat within 3 dB from dc to 32 MHz.

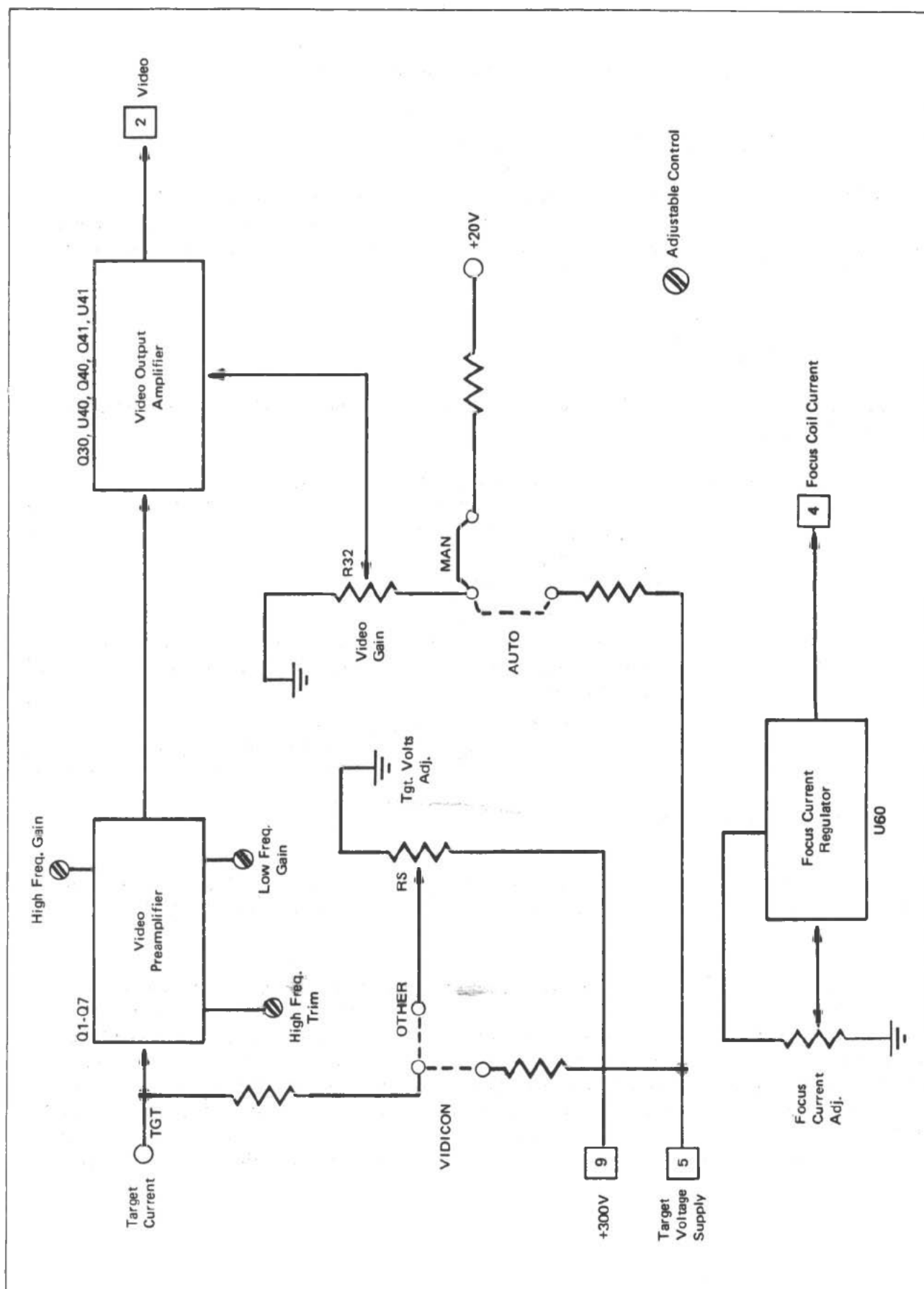


Figure 3-1. Block Diagram, Video Preamplifier Module

The video signal that appears at the output of the video preamplifier (as TP1) has a nominal amplitude of 170 millivolts p-p when the target signal current is 300 nanoamperes p-p. This video signal drives an output amplifier formed with transistors Q30, Q40, Q41 and integrated circuits U40 and U41 and having a gain that is controlled with negative feedback through Q30, a transistor that operates as a variable resistor. Depending on the position of an AUTO-MAN jumper on the board the amount of resistance introduced into the amplifier feedback loop by Q30 is either set with GAIN control R32 or it is varied with the target voltage signal entered into the module at terminal 5 and supplied from the 7900 Camera Control. In either case the output amplifier gain is such that its output signal has a nominal 200 millivolts p-p amplitude. The dc level of this video signal is stabilized with U41, an integrating amplifier. If the dc level of the signal attempts to drift, an error signal is generated by U41. This error signal modifies the bias on U40, a differential amplifier stage, so as to restore the dc level of the video output signal to normal.

The focus current regulator section of the video preamplifier module is formed with integrated circuit U60 and a power transistor (Q1). The latter, which is located on the camera chassis for heat-dissipation reasons, operates as a series-pass stage for the dc current that is supplied to the focus coil at the image tube. This same current flows through R61 where it develops a feedback signal that is compared at differential amplifier U60 with a dc reference level set with potentiometer R64. Any change in the normal level of focus coil current, as set with R64, causes the amplifier to supply a dc error signal at U60-10. This error signal modifies the bias on Q1 by whatever amount is required to maintain a constant current in the focus coil.

3-4. MAINTENANCE ADJUSTMENTS

Video preamplifier module A4 has eight adjustable controls, the functions of which are described in Table 3-2. Their locations in the module can be determined with the aid of Figure 2-4, Section II. The procedure to use in checking or changing the settings of these controls is in the Camera Maintenance section (Section II).

3-5. WAVEFORMS

Typical waveforms that should be present at certain terminals in video preamplifier module A4 are shown in Figure 3-2.

3-6. REPLACEMENT PARTS

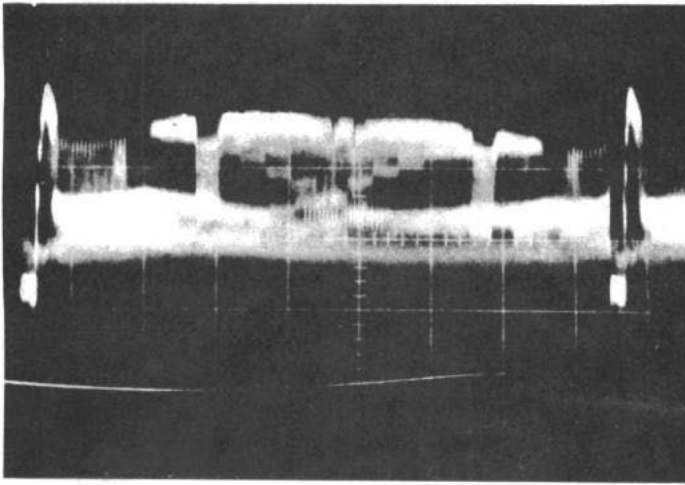
Replacement parts that can be ordered from Cohu or any of its sales representatives are listed in Table 3-3.

3-7. SCHEMATIC

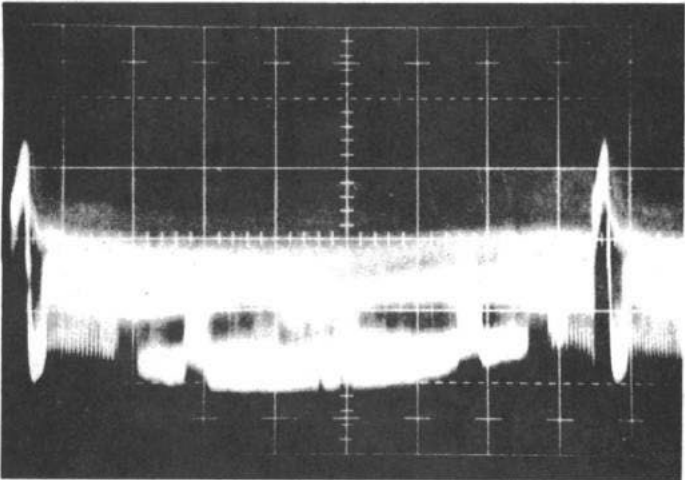
A schematic for the circuits in video preamplifier module A4 is in Figure 3-3.

Table 3-2. Internal Adjustable Controls, Video Preamplifier Module A4

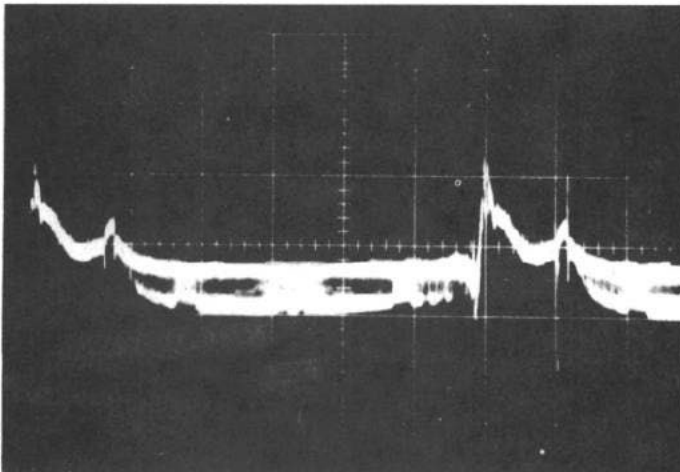
CONTROL	CIRCUIT DESIGNATOR	FUNCTION
Target Volts	R5	Adjusts dc potential on target of image tube when the image tube in the camera is the lead oxide or silicon diode array type
High-Frequency Gain	C9	Sets high frequency response of video preamplifier Q1 through Q7
High-Frequency Response Trimmer	C11	Adjusts over a narrow trim range the high-frequency response of video preamplifier Q1 through Q7
Low-Frequency Compensation	C10	Set low-frequency response of video preamplifier Q1 through Q7
Video Gain	R32	Sets peak-to-peak amplitude of video signal at module output terminal Z
Focus Current	R64	Sets level of dc current supplied to focus coil at image tube
MAN—AUTO Jumper		When jumper is in MAN position the video gain is preset with GAIN control R32. If jumper is in AUTO position the gain is controllable with an auto-target signal entered into the module at terminal 5.
VIDICON - OTHER Jumper		If image tube in camera is a vidicon the jumper is located in VIDICON position and target voltage is controllable with an auto-target signal entered into the module at terminal 5. If image tube is not a vidicon the jumper is located in the OTHER position and target voltage is set with TGT VOLTS control R5



TP1: 2ms/cm; 20 mV/cm



TP30: 2ms/cm; 0.1V/cm



TP30: 10 μ s/cm; 0.2V/cm

Figure 3-2. Video Preamplifier Waveforms

Table 3-3. Replacement Parts for Video Preamplifier Board A4

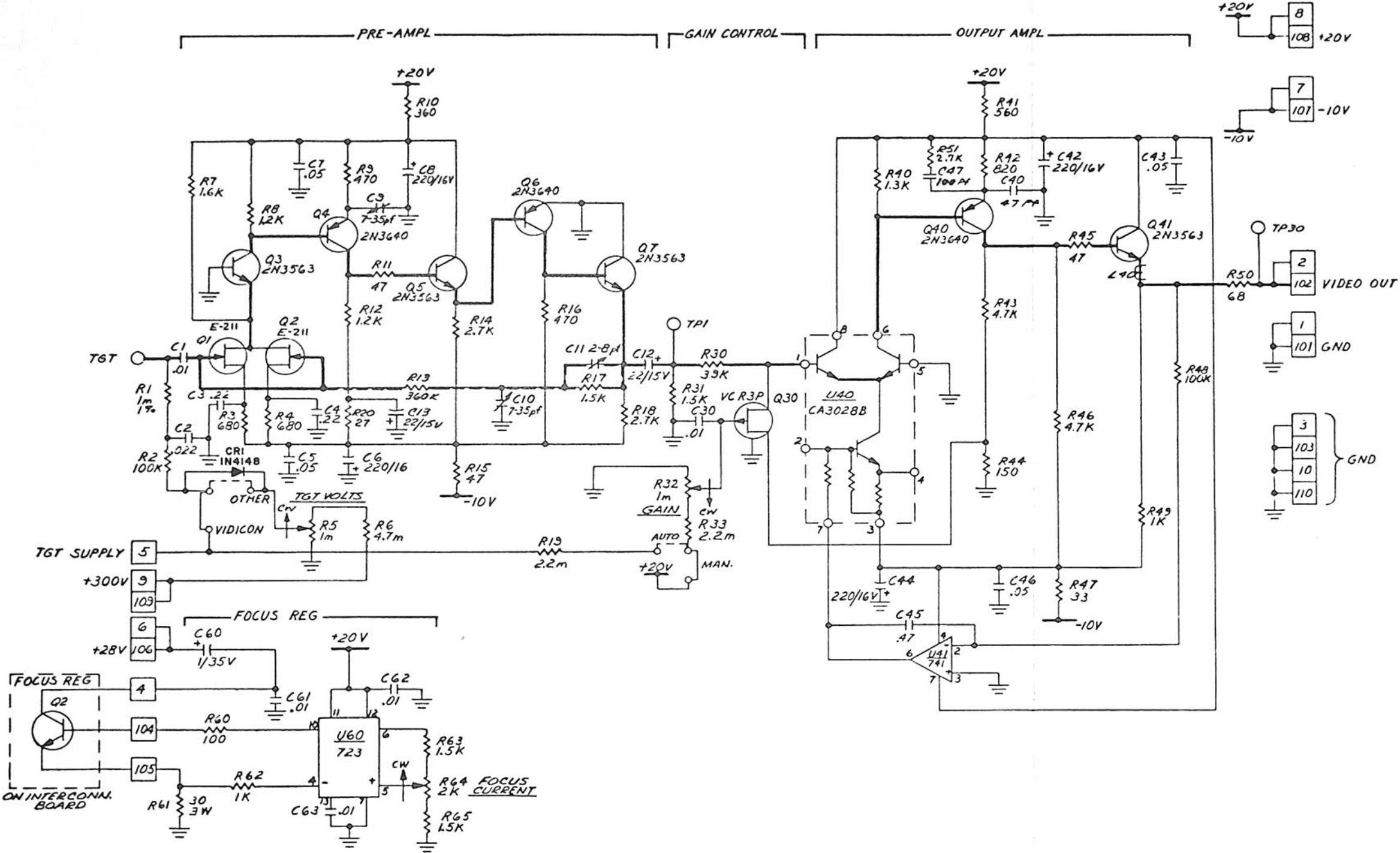
REF DES	DESCRIPTION	COHU PART NUMBER
CAPACITORS		
NOTE: All capacitor values are listed in microfarads unless otherwise specified.		
C1	.01 @ 200V, polyester film	0610128-103
C2	.022 @ 100V, film	0610136-223
C3, C4	0.22 @ 100V, film	0610136-224
C5	.05 @ 50V, ceramic	0410009-503
C6	220 @ 16V, electrolytic	0510160-009
C7	.05 @ 50V, ceramic	0410009-503
C8	220 @ 16V, electrolytic	0510160-009
C9, C10	7pf to 35pf, variable mica	0910013-003
C11	2pf to 8ph, variable mica	0910013-002
C12, C13	22 @ 15V, tantalum	0510155-005
C14 thru C29	Not used	
C30	.01 @ 50V, ceramic	0410009-103
C31 thru C39	Not used	
C40	47ph @ 300V, 10%, silver mica	1010005-470
C41	Not used	
C42	220 @ 16V, electrolytic	0510160-009
C43	.05 @ 50V, ceramic	0410009-503
C44	220 @ 16V, electrolytic	0510160-009
C45	0.47 @ 100V, mylar	0610136-474
C46	.05 @ 50V, ceramic	0410009-503
C47	100pf @ 500V, silver mica	1010006-101
C48 thru C59	Not used	
C60	10 @ 35V, 20%, tantalum	0510155-008
C61 thru C63	.01 @ 50V	0410009-103
DIODES		
CR1	1N4148 diode switch	3510042-029
INDUCTORS		
L40	.118 henry shielding bead	4910020-001
RESISTORS		
NOTE: All resistors are carbon whose values are listed in ohms, $\pm 5\%$ tolerance, and $\frac{1}{4}$ watt rating unless otherwise specified.		
R1	1M, 1%, film	4710044-015
R2	100k	4010025-104
R3, R4	680	4010025-681
R5	1M, $\frac{3}{4}$ watt potentiometer	5010135-105
R6	4.7M	4045000-475
R7	1.6k	4010025-162
R8	1.2k	4010025-122

Table 3-3. Replacement Parts for Video Preamp Board (cont.)

REF DES	DESCRIPTION	COHU PART NUMBER
R9	RESISTORS (cont.)	
R9	470	4010025-471
R10	360	4010025-361
R11	47	4010025-470
R12	1.2k	4010025-122
R13	360k	4010025-364
R14	2.7k	4010025-272
R15	47	4010025-470
R16	470	4010025-471
R17	1.5k	4010025-152
R18	2.7k	4010025-272
R19	1.8M	4045000-185
R20	27	4010025-270
R21 thru R29	Not used	
R30	15k	4010025-153
R31	1.5k	4010025-152
R32	1M, ¼watt potentiometer	5010135-105
R33	2.2M	4010025-225
R34 thru R40	Not used	
R41	390	4010025-391
R42	820	4010025-821
R43	4.7k	4010025-472
R44	150	4010025-151
R45	47	4010025-470
R46	4.7k	4010025-472
R47	33	4010025-330
R48	100k	4010025-104
R49	470	4010025-471
R50	68	4010025-680
R51	2.7k	4010025-272
R52 thru R59	Not used	
R60	100	4010025-101
R61	30, ± 1%, 3 watts	5110039-006
R62	1k	4010025-102
R63	1.5k	4010025-152
R64	2k	5010135-202
R65	1.5k	4010025-152
	TRANSISTORS	
Q1, Q2	Type E211	7210112-002
Q3	Type 2N3703	7210068-005
Q4	Type 2N3640	7210068-002
Q5	Type 2N3703	7210068-005
Q6	Type 2N3640	7210068-002
Q7	Type 2N3703	7210068-005
Q8 thru Q29	Not used	
Q30	Type VCR3P	7210105-001

Table 3-3. Replacement Parts for Video Preamp Board (cont.)

REF DES	DESCRIPTION	COHU PART NUMBER
	TRANSISTORS	
Q31 thru Q39	Not used	
Q40	Type 2N3640	7210068-002
Q41	Type 2N3703	7210068-005
	INTEGRATED CIRCUITS	
U1 thru U39	Not used	
U40	Cascode differential amplifier, type CA3028	3610134-001
U41	Operational amplifier, type 741	3610108-001
U42 thru U59	Not used	
U60	Voltage regulator, type VA723C	3610071-003



2. All Capacitors are in Microfarads
1. All Resistors are in Ohms 1/4watt, ±5%
NOTES: UNLESS OTHERWISE SPECIFIED

Figure 3-3. Schematic,
Video Preamplifier Module A4
(Dwg. D8458240C)

7120/7210B SERIES
SECTION IV
DEFLECTION MODULE A3

4-1. GENERAL DESCRIPTION

Deflection module A3 that forms a part of the 7120 Series Camera is a printed circuit board assembly located in the camera where shown in Figure 2-1, Section II. The circuits in it: (1) generate a sawtooth current waveform for the horizontal deflection coil at the image tube; (2) control the deflection failure indicator lamp on the front of the 7900 Series Camera Control unit; and (3) generate two high-voltage dc potentials for grids 3 and 4 of the image tube.

4-2. INPUTS AND OUTPUTS

Dc supply voltages and signals that enter or exit at the interface terminals of the deflection module are described in Table 4-1.

Table 4-1. Inputs and Outputs, Deflection Module A3

INPUT POWER	
+20 volts dc (terminal 3)	
+28 volts dc (terminal 2)	
- 10 volts dc (terminal 4)	
INPUT SIGNALS	
Horizontal drive (terminal 112):	Negative-going, four-volt p-p pulse occurring at horizontal scan rate. The width of the pulse is 5.6 microseconds for 525-line cameras and about 3.6 microseconds for cameras with higher line rates
Horizontal size control (terminal 12):	Adjustable dc potential in range from +20 volts
Vidicon cathode (terminal 13):	Positive-going, 20-volt, mixed horizontal and vertical blanking pulses if camera is operating normally. If a scan failure exists, the signal is a steady +20 volts dc
Vertical deflection high (terminal 11):	Sawtooth waveform that repeats at the rate of 60 Hz and has an amplitude of about 20 volts p-p
Focus control (terminal 105):	Adjustable dc potential that falls in range from zero to +20 volts
Horizontal centering (terminal 111):	Adjustable dc current
OUTPUT DC VOLTAGES	
G4 (terminal 7):	Adjustable potential that is set at +1000 volts
G3 (terminal 8):	Adjustable potential that is set at +700 volts

Table 4-1. Inputs and Outputs, Deflection Module A3 (cont.)

OUTPUT DC VOLTAGES	
Protection indicator (terminal 106):	+0.6 volts if camera is operating normally. If a deflection failure exists the signal is +90 volts dc
Horizontal yoke top (terminal 10):	Positive, 3-microsecond pulse that repeats at horizontal scan rate and has an amplitude of approximately 110 volts
G4 (terminal 7):	+1000 volts dc or as otherwise set with R28
G3 (terminal 8):	+700 volts dc or as otherwise set with R22

4-3. CIRCUIT DESCRIPTION

A functional block diagram of the circuits in the deflection module is shown in Figure 4-1. The schematic for the module can be found at the end of the section. For descriptive purposes the circuits in the module can be divided into: (1) a horizontal deflection waveform generator; (2) an image tube protection circuit; (3) a deflection failure indicator lamp control; and (4) a regulated high-voltage supply. The descriptions are under corresponding headings in Paragraphs 4-4 through 4-7.

4-4. HORIZONTAL DEFLECTION WAVEFORM GENERATOR

This circuit is formed with integrated circuit U50 and transistors Q50, Q51, Q1. It generates at the horizontal scan rate a pulse that is applied across the horizontal deflection coil. To develop the pulse a negative-going, rectangular-shaped, four-volt p-p horizontal drive pulse (Table 4-1) that enters the module at terminal 112 first is amplified by transistor Q50 and interstage transformer T50. The amplified pulse drives transistor switch Q51 which supplies the current for the horizontal deflection coil and which conducts only while the scanning beam is tracing horizontally. At the start of each horizontal retrace the horizontal drive pulse makes Q51 switch to cutoff, thus stopping current flow through the horizontal deflection coil and causing the magnetic field surrounding it to collapse. A ringing action then starts in a resonant circuit formed with C56, C58, L52 and the horizontal deflection coil. This oscillation causes a high-speed reversal of current flow in the deflection coil, thereby developing a magnetic field that deflects the scanning beam rapidly in the retrace direction. After the first half cycle of the ringing diode CR51 conducts and damps out the oscillation. The resulting current waveform in the deflection coil is a sawtooth. This sawtooth has a ramp that is linearized with L52, a saturable reactor.

The amplitude of the sawtooth current waveform in the deflection coil establishes the width of the scanning pattern on the image tube target and is a direct function of the dc potential between the collector and emitter of Q51. This potential is controlled with negative-feedback amplifier U50, Q1. The dc level of the sawtooth current waveform in the deflection coil establishes the horizontal position of the scanning pattern and is set through choke L51 and reactor L52 with an adjustable HORIZONTAL CENTERING control located at the 7900 Series Camera Control.

A flyback pulse is developed across the horizontal deflection coil at the start of each retrace. This pulse is used to turn off the scanning beam at the image tube and it is coupled to the image tube cathode through R56 and C55.

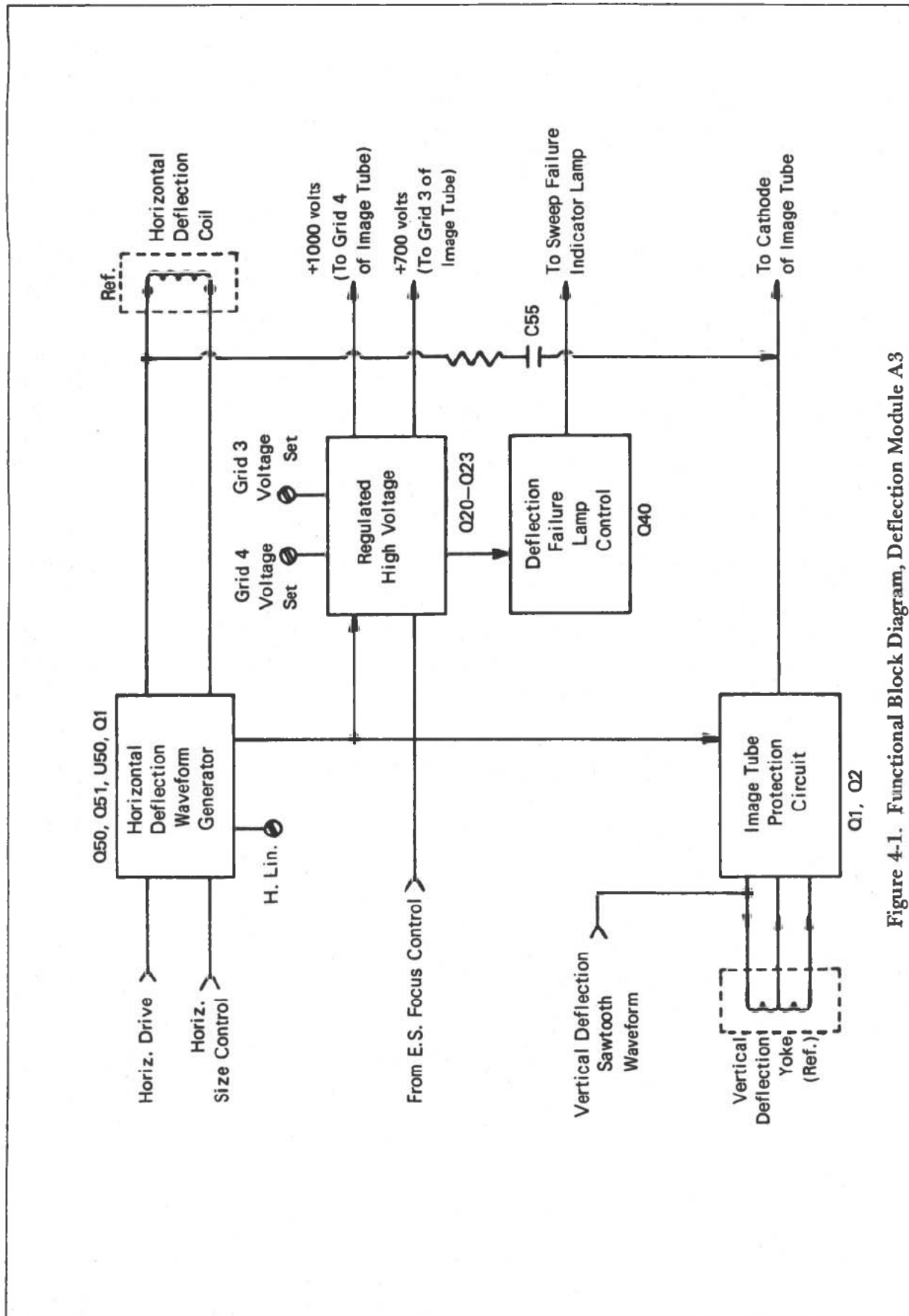


Figure 4-1. Functional Block Diagram, Deflection Module A3

4-5. IMAGE TUBE PROTECTION CIRCUIT

This circuit is formed with transistor stages Q1 and Q2. When the scanning circuits are operating correctly the circuit supplies to the cathode of the image tube a positive pulse to bias off the scanning beam at vertical retrace times. If a vertical deflection failure exists the circuit supplies instead a continuous positive dc potential that keeps the beam biased off until scanning is returned to normal.

The circuit is driven at the base of Q1 with a sawtooth waveform that appears across the vertical deflection coil. During vertical trace times the positive slope of this waveform biases off Q1. At the same time, Q2 is biased off with a positive charge developed on C2 by current flow in CR1. Also, the collector of Q2 is grounded due to CR1 being forward-biased with a negative potential fed through R5. This collector potential at Q2 grounds the cathode of the image tube to turn on the scanning beam. At the start of vertical retrace, or if a vertical deflection failure exists, the negative peak of the vertical deflection coil waveform, or its absence, causes both Q1 and Q2 to switch to their conducting states, thus driving the collector of Q2 to approximately the same potential as the emitter, which is tied to the +20 volt bus. This +20 volts on the Q2 collector biases off the scanning beam. If this action was caused by a vertical deflection failure, Q2 will stay biased on through R5 and C3 then will charge up via R17 to the Q2 collector potential to disable the high-voltage supply (Paragraph 4-7) and remove the high voltages from grids 3 and 4 of the image tube.

During the horizontal retrace period a positive pulse is applied through C55 from the horizontal deflection waveform generator (Paragraph 4-4). This pulse forward-biases diode CR3 to clamp the cathode of the image tube to +20 volts. In the case of a horizontal deflection failure, the positive pulse from the horizontal deflection waveform generator will not appear. There then will be no drive for the high-voltage supply (Paragraph 4-7), and the high voltage potentials which the supply develops will be removed from grids 3 and 4 of the image tube.

4-6. DEFLECTION FAILURE INDICATOR LAMP CONTROL

This circuit is constructed with transistor Q40, capacitor C40 and resistors R40 through R42. If a horizontal or vertical deflection failure occurs, the circuit generates a positive dc potential that energizes a deflection failure indicator lamp located at the 7900 Series Camera Control.

While the deflection circuits are functioning normally, transistor Q40 is biased off through R42 and the dc potential at the Q40 collector is insufficient to ignite the deflection failure indicator lamp, a neon bulb wired to terminal 106. On occurrence of a horizontal or a vertical deflection failure the high voltage supply (Paragraph 4-7) becomes disabled and the dc potential it supplies through R41 rises to a positive level that biases on Q40. While Q40 conducts, its collector is a ground potential and the voltage applied across the deflection failure indicator lamp is 90 volts, the firing potential of the lamp.

4-7. REGULATED HIGH VOLTAGE SUPPLY

This supply is formed with transistors Q20 through Q23. It is used to develop the two high-voltage dc potentials that are applied to grids G3 and G4 of the image tube. It also generates a dc signal that is used as an input to the deflection failure indicator lamp control circuit (Paragraph 4-6).

At the circuit input a positive pulse is applied to the base of Q20 through capacitor C20. This pulse repeats at the horizontal scan rate (Table 1-1) and originates at the horizontal deflection circuit

(Paragraph 4-4). At Q20 the pulse is shaped and reversed in polarity to provide a negative-going pulse with a fast-falling leading edge for the base of Q21. A diode (CR20) at the base of Q21 clamps the most negative edge of the pulse to ground, which adds to the pulse waveform a dc level that biases on Q21 between pulses. Whenever the pulse appears at the base of Q21 the transistor stops conducting and a large, positive flyback pulse is developed across the secondary of autotransformer T20. The negative excursion of this flyback pulse is damped out with diode CR21 to prevent ringing.

The flyback pulse that appears across the secondary winding of T20 is rectified by CR22 and filtered by C23 to provide a smooth +1000 volts for the accelerating grid (G4) of the image tube. This same +700 volts at the wiper arm of R22. The latter potential is routed from there to grid G3 of the image tube. Both the +1000 volts and the +700 volts are adjustable simultaneously with R28 (or with a FOCUS control located at the 7900 Series Camera Control), and both voltages are regulated by comparing the voltage at the junction of R23 and R25 with the regulated -10 volt supply. Any change in the difference in potential between the two is amplified by Q22 and used to control the bias on Q23, a series-pass transistor that provides the collector voltage for power stage Q21.

If a horizontal deflection failure occurs a drive pulse no longer is supplied by the horizontal deflection circuit to the base of Q20. The high voltage supply then becomes inoperative to remove the +1000 volts and +700 volts from its output terminals. Also, the dc potential that the supply provides as the input signal for the deflection-failure indicator lamp control from the emitter of Q23 (Paragraph 4-6) rises from a normal +20 volts. The aforementioned things also occur if there is a vertical deflection failure. In the latter case, the dc potential provided by the supply to the deflection-failure indicator lamp control circuit through R41 switches from about -0.6 volt to about +20 volts to hold Q40 in the saturation state.

4-8. MAINTENANCE ADJUSTMENTS

There are three adjustable controls in the deflection module. Their functions are described in Table 4-2. Their locations can be determined with the aid of Figure 2-5, Section II. Instructions on how to adjust these controls can be found in Section II, Paragraphs 2-9 and 2-11.

4-9. WAVEFORMS

Waveforms that should be present typically at various test points in the deflection module are shown in Figure 4-2. These waveforms were taken in a camera having a 525-line, 30-frame, 2:1 interlaced scanning pattern.

4-10. REPLACEMENT PARTS

Replacement parts that can be ordered from Cohu or any of its sales representatives for the deflection module are listed in Table 4-3.

4-11. SCHEMATIC

A schematic for the circuits in the deflection module is in Figure 4-3.

Table 4-2. Adjustable Controls, Deflection Module A3

CONTROL	CIRCUIT DESIGNATOR	FUNCTION
Horizontal Linearity	L52	Adjusts linearity of horizontal scan
+700 Volt Set	R22	Adjusts output of G3 regulated dc voltage supply
HV Set	R28	Adjusts output of both G3 and G4 regulated dc voltage supplies

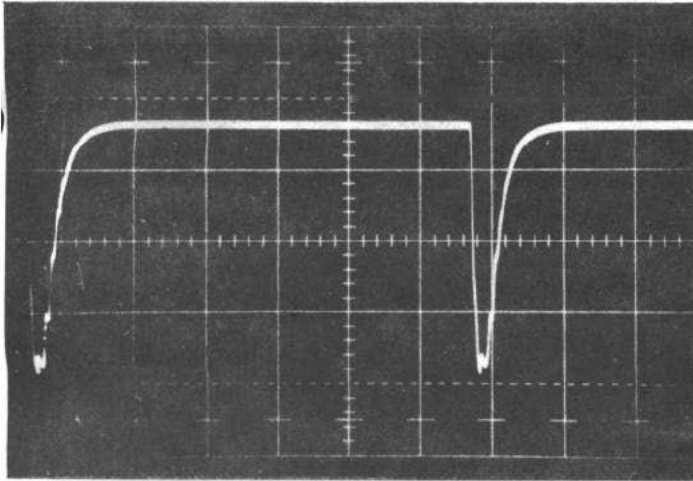
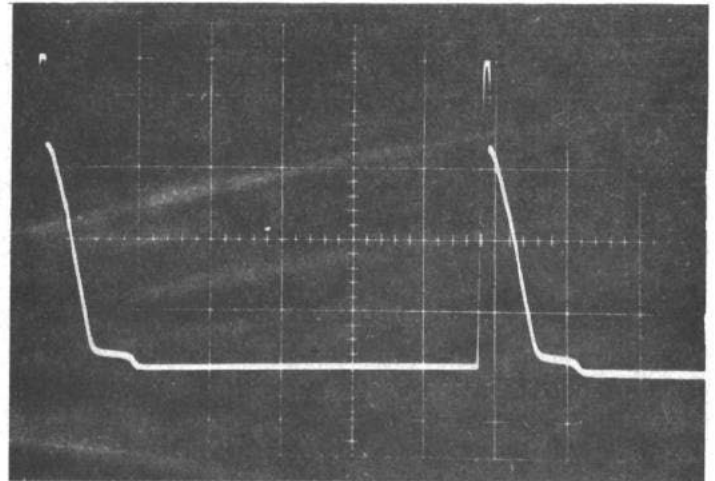
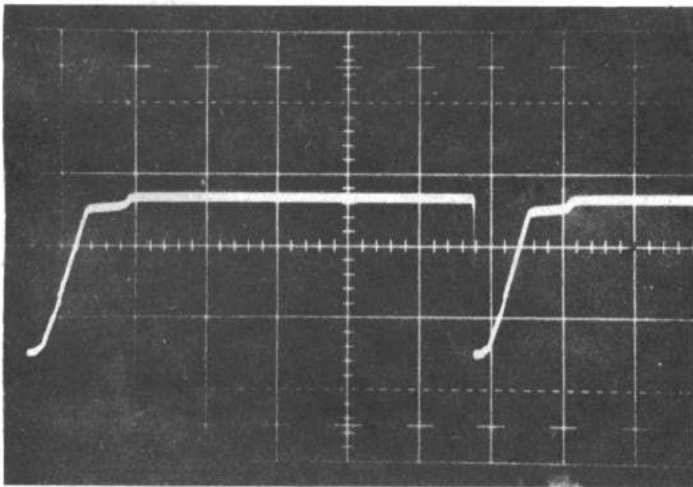
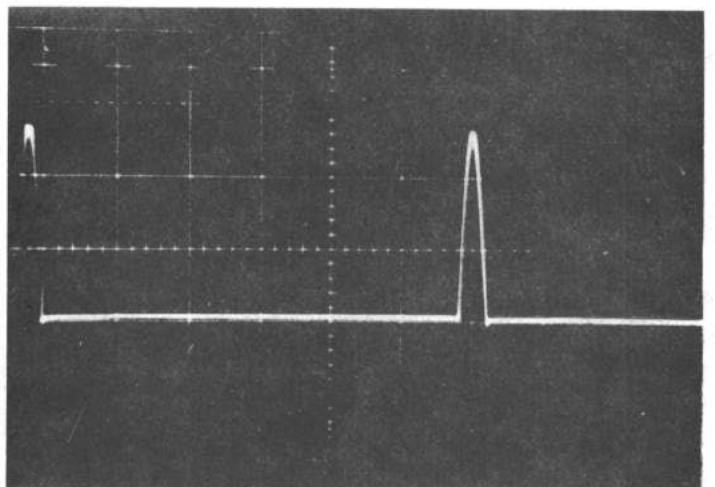
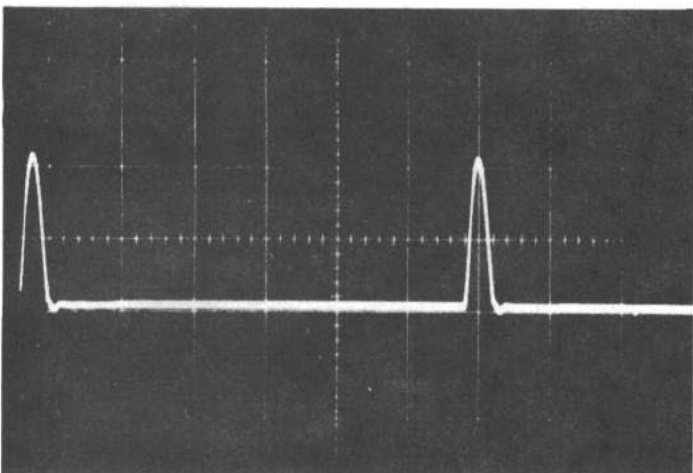
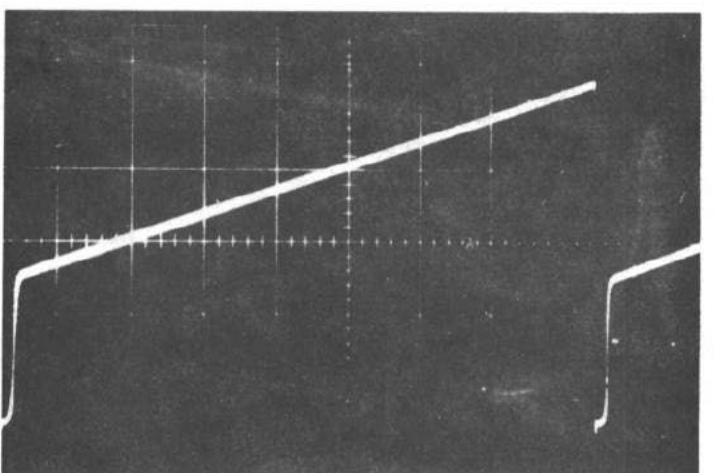
Terminal 112: $10\mu\text{s}/\text{cm}$; $1.0\text{V}/\text{cm}$ Q50 Collector: $10\mu\text{s}/\text{cm}$; $5\text{V}/\text{cm}$ Q51 Base: $10\mu\text{s}/\text{cm}$; $5\text{V}/\text{cm}$ Q51 Collector: $10\mu\text{s}/\text{cm}$; $50\text{V}/\text{cm}$ TP50: $10\mu\text{s}/\text{cm}$; $50\text{V}/\text{cm}$ TP1: $2\text{ ms}/\text{cm}$; $2\text{V}/\text{cm}$

Figure 4-2. Deflection Module Waveforms

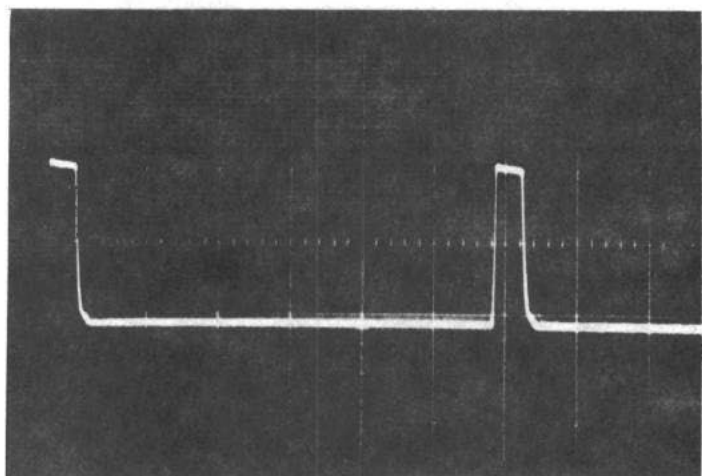
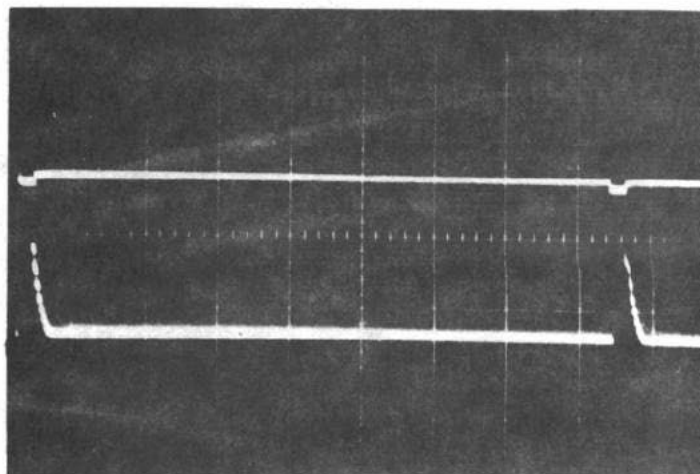
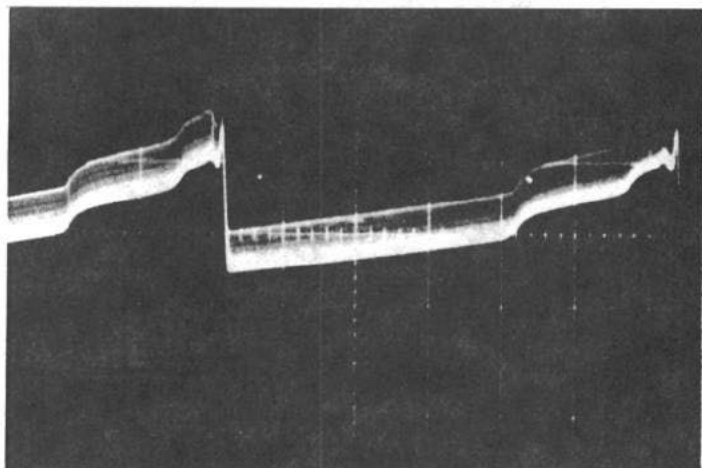
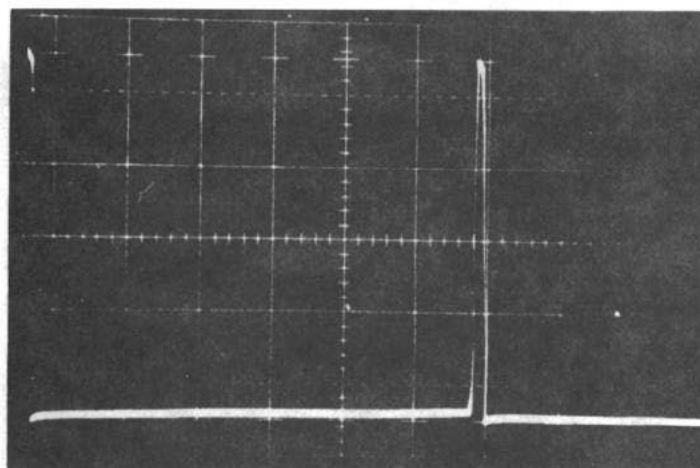
Q2 Collector: $10\mu\text{s}/\text{cm}$; $10\text{V}/\text{cm}$ Q2 Collector: $2\text{ms}/\text{cm}$; $10\text{V}/\text{cm}$ Q20 Collector: $10\mu\text{s}/\text{cm}$; $2\text{V}/\text{cm}$ Q21 Collector: $10\mu\text{s}/\text{cm}$; $50\text{V}/\text{cm}$

Figure 4-2. Deflection Module Waveforms

Table 4-3. Replacement Parts for Deflection Board A3

REF DES	DESCRIPTION	COHU PART NUMBER
	CAPACITORS	
	NOTE: All capacitor values are listed in microfarads unless otherwise specified.	
C1	Not used	
C2	2.2 @ 25V, tantalum	0510155-002
C3	.10 @ 100V, film	0610136-104
C4 thru C19	Not used	
C20, C21	0.47 @ 100V, mylar	0610136-474
C22	.047 @ 100V, film	0610136-473
C23	.02 @ 140V, line by-pass	0410013-001
C24	.01 @ 100V, film	0610136-103
C25	22 @ 25V, electrolytic	0510156-226
C26 thru C39	Not used	
C40	.02 @ 500V, ceramic disc	0401058
C41 thru C49	Not used	
C50	220 @ 25V, electrolytic	0510160-018
C51	.10 @ 100V, film	0610136-104
C52	47 @ 25V, electrolytic	0510160-016
C53	.10 @ 100V, film	0610136-104
C54	.022 @ 100V, film	0610136-223
C55	.047 @ 100V, film	0610136-473
C56	1500pf @ 500V, silver mica	1010007-152
C57	0.47 @ 100V, mylar	0610136-474
C58	100 @ 20V, tantalum	0510135-013
C59	500pf @ 500V, silver mica	1010006-501
C60	22 @ 6V, tantalum	0510146-001
C61	.10 @ 100V, film	0610136-104
C62	47 @ 25V, electrolytic	0510160-016
	DIODES	
CR1 thru CR 3	Type 1N457, silicon	3510042-022
CR4 thru CR19	Not used	
CR20	Type 1N457, silicon	3510042-022
CR21	Type 1N4007	3510018-018
CR22	Type SFM30	3510076-004
CR23 thru CR50	Not used	
CR51	Type 1N93	3510025-003
	INDUCTORS & COILS	
	NOTE: Note inductance values listed in millihenries unless otherwise specified.	
L1	10, coil	2310037-001
L2 thru L49	Not used	
L50, L51	10, coil 83 to 105 ohms	2310039-001
L52	160 to 980 adjustable inductor	2390063-002

Table 403. Replacement Parts for Deflection Board A3 (cont.)

REF DES	DESCRIPTION	COHU PART NUMBER
	RESISTORS	
	NOTE: Resistors are carbon and listed in ohms, $\pm 5\%$ tolerance, and $\frac{1}{4}$ watt rating unless otherwise specified.	
R1, R2	1.5k	4010025-152
R3	1k	4010025-102
R4	10k	4010025-103
R5	100k	4010025-104
R6	10k	4010025-103
R7	22k	4010025-223
R8	15k	4010025-153
R9	1k	4010025-102
R10 thru R19	Not used	
R20	1k	4010025-102
R21	1watt, composition	4010025-685
R21	4.7M, $\frac{1}{2}$ watt (camera serial numbers 2-006) and on	0310031-475
R22	5M, potentiometer	5010115-505
R23	12M, 1watt, composition	4010025-126
R24	22k	4010025-223
R25	470k	4010025-474
R26	1k	4010025-102
R27	1.5M	4010025-155
R28	10k, $\frac{1}{2}$ watt potentiometer	5010135-103
R29	4.7k	4010025-472
R30 thru R39	Not used	
R40	2.7k	4010025-272
R41	13k (camera serial numbers 2-0006 and on)	4010025-133
R42	10k	4010025-103
R43 thru R49	Not used	
R50	18k	4010025-183
R51	56	4010025-560
R52	150k	4010025-154
R53	10k	4010025-103
R54	22	4010025-220
R55	10	4010025-100
R56	2.2k	4010025-222
R57	47k	4010025-473
R58	1.5k	4010025-152
R59	4.7k	4010025-472
R60	1.3k	4010025-132
R61	22	4010025-472
	TRANSISTORS	
Q1, Q2	Type 2N3905	7210072-001
Q3 thru Q19	Not used	
Q20	Type MPS-A14	7210095-001
Q21	Type 2N3439	7210035-057
Q22	Type 2N5462	7210084-003

Table 4-3. Replacement Parts for Deflection Board A3 (cont.)

REF DES	DESCRIPTION	COHU PART NUMBER
	TRANSISTORS (cont.)	
Q23	Type 2N3439	7210113-001
Q24 thru Q39	Not used	
Q40	Type 2N3567	7210069-002
Q41 thru Q49	Not used	
Q50	Type 2N4890	7210035-051
Q51	Type 2N3584	7210071-009
	INTEGRATED CIRCUITS	
U1 thru U49	Not used	
U50	Operational amplifier, type 741	3610108-001
	TRANSFORMERS	
T1 thru T19	Not used	
T20	Pulse 1:3 auto transformer	8458236-001
T21 thru T49	Not used	
T50	Pulse 1:2 imp. ratio transformer	8458235-001



4-13/4-14

0.165 H
0.175 H

ASPECT RATIO IS 4/3-HORIZONTAL BLANKING 17.5%-VERTICAL BLANKING 7.5%
ELECTRICAL GRATING PATTERN GENERATOR FREQUENCIES: 315 KC HORIZONTAL, 900 CYCLE VERTICAL

0.075 V
0.065 V

0.075 V
0.065 V

CIRCLES OUTER RADII ARE 2% OF PICTURE HEIGHT

CIRCLES INNER RADII ARE 1% OF PICTURE HEIGHT

0.175 H
0.165 H

WARRANTY

Cohu, Inc., Electronics Division, warrants equipment manufactured to be free from defects of material and workmanship. Any part or parts will be repaired or replaced when proven by COHU examination to have been defective within one year from date of shipment to the original purchaser. All warranty repairs will be performed at the factory or as otherwise authorized by COHU in writing. Transportation charges shall be prepaid by purchaser.

This warranty does not extend to COHU equipment subjected to misuse, accident, neglect or improper application, nor repaired or altered by other than COHU or those authorized by COHU in writing. Television image pickup tubes are warranted by the original manufacturer.

This warranty is in lieu of all other warranties express or implied. COHU shall not be liable for collateral or consequential damages.

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